

Engineering Reference Manual



CHESTERFIELD COUNTY, DEPARTMENT OF ENVIRONMENTAL ENGINEERING
February 12, 2007

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GENERAL POLICY FOR DRAINAGE AND HYDROLOGY

It is recognized that the public demand for adequate drainage within and adjacent to developments requires the attention of qualified professionals to solve the problems of design, construction and maintenance. In this light, it is desired that engineers and surveyors* seek and apply the most up-to-date technical information available and treat every problem separately in order to obtain the best design possible. Qualified professionals should be encouraged to seek new and better solutions to complicated technical problems. In the interest, however, of expediting the processing of plans and construction, certain standard procedures and the use of standards of design are, in most cases, necessary if there is to be orderly, controlled development within the County. Experience has also indicated that review and construction can be expedited and economies obtained through the use of standard structures and construction methods familiar to local contractors, local engineers and field inspection personnel.

The following memoranda contains certain specific requirements based on Federal Codes, State Codes, County Codes, Ordinances, Resolutions and Policies, as well as specific standards of the Virginia Department of Transportation (VDOT) from which variances may not be granted by Engineering officials at the local level. There are also uniform required standards of form, size of drawings, scales and presentation of plans and computations which have evolved over the years, which help expedite review. This information is intended to be used by both professional designers and by County personnel reviewing the design as guidelines and professional reminders.

As new and better design criteria become available and accepted practices and as Federal, State and County regulations change, subsequent memoranda will be issued to either supplement or revise existing requirements. Unless otherwise stated herein, all work and materials shall conform to the most current editions of the Road and Bridge Specifications, the Road Designs and Standards and the VDOT Drainage Manual.

Adequate drainage must have the hydraulic characteristics to accommodate the maximum expected flow of storm waters for a given watershed, or portion thereof, for a specified duration and intensity of rainfall.

Drainage must be designed to adequately account for (1) off-site water in its developed state, (2) on-site water, and (3) conveying of said stormwater to a point where it will flow by gravity into an adequate natural stream, water channel, natural drainage- way, or where it can be connected into existing facilities of sufficient capacity to receive the same.

If the existing facility is not sufficient to receive the proposed drainage, then there are basically two alternatives, (1) the developer, at his expense, enlarges or does whatever is necessary to upgrade the existing system, or (2) the developer can retain/detain, on-site, in conjunction with the retention policy in such a manner as to make the existing system adequate. Drainage structures should be constructed in such a manner that they can be maintained at a reasonable cost and not be a nuisance to the adjacent homeowners. To facilitate design, construction and maintenance, said drainage should meet or conform insofar as practical to County and VDOT standards.

Determination of the size and capacity of an adequate drainage system shall take into account the planned development in the watershed or affected portions thereof as presently zoned or as shown on the most currently approved land use and transportation plan. The design should not adversely affect adjacent or neighboring properties.

It has been a continuing policy of Chesterfield County that the owner or developer of property shall not concentrate or discharge damaging stormwater on a downstream property where it was not concentrated before unless he acquires an easement for the conveyance of stormwater across that property and other lower lying property until an adequate natural watercourse or an adequate drainage system, (pipe or channel, etc.) is reached.

*The State registration law limits 3B Surveyors to the use of these standard designs.

"Adequate natural watercourse" will be construed to mean that the natural eroded channel has the capacity to contain a 2 year peak flow based on future development.

If off-site easements are needed to reach the 2 year containment, the improvements needed through the easement will be designed for the 10 year ultimate capacity.

Within subdivision and commercial developments, the "Rational Formula" will be considered as reliable for computing peak runoff for watersheds less than 200 acres. For watersheds equal to or great than 200 acres, one of the following methods is recommended for use (see table):

APPROPRIATE RUNOFF CALCULATION METHODS

Calculation Methods:

1. Peak Discharge Method - SCS-TR No. 55
2. Tabular Method - SCS-TR No. 55
3. Unit Hydrograph Method - SCS-NEH Section 4

<u>Output Requirements</u>	<u>Appropriate Drainage Area</u>	<u>Method</u>
Peak Discharge Only	200 to 2000 acres 2000 acres to 20 sq. mi. above 20 sq. mi.	1, 2 or 3 2 or 3 3
Peak Discharge and Total Runoff Volume	up to 2000 acres 2000 acres to 20 sq. mi. above 20 sq. mi.	1, 2 or 3 2 or 3 3
Runoff Hydrograph	up to 20 sq. mi. above 20 sq. mi.	2 or 3 3

The runoff coefficients ("C") shall be determined by giving due consideration to the existing and, particularly, the potential ultimate development in the upstream limits of the watershed as designed on the appropriate Land Use and Transportation Plan, or by current rezoning trends in the area and existing zoning. The "C" factors shown in this section and the VDOT Drainage Manual may be used as a guide. However, in cases where a paved roadway or parking lot, for example, is exclusively contributing to a point of concentrated flow under study, then the individual corresponding "C" factor shall apply in lieu of averaging weighted runoff coefficients to represent the type of development.

On-site hydrology procedures for subdivisions in which the rights-of-way will be taken over by VDOT will call for those right-of-way areas to be delineated from the adjacent land areas or separate contributing drainage areas to their common structure.

All off-site contributing drainage areas must be shown with the appropriate information assumptions.

Runoff Coefficients "C" Factors

Chesterfield County accepted runoff coefficients "C" factors:

I. Subdivisions

	<u>Description</u>	<u>"C" Factor</u>
A.	Curb and gutter right-of-way	0.90

	<u>Description</u>	<u>"C" Factor</u>
B.	Roadside ditch right-of-way	0.80
C.	Land area:	
1.	R-7	0.50
2.	R-9	0.45
3.	R-12	0.40
4.	R-15	0.35
5.	R-25	0.30
6.	R-40	0.25
7.	R-88	0.25

II. Other Uses

	<u>Description</u>	<u>"C" Factor</u>
A.	Curb and gutter right-of-way	0.90
B.	Roadside ditch right-of-way	0.80
C.	Paved parking lots (surface treatment, asphalt or concrete	1.00
D.	Buildings	0.80 to 0.90
E.	Buffers and open spaces:	
1.	Improved:	
a.	wooded	0.30
b.	non-wooded	0.35
2.	Natural:	
a.	wooded	0.20
b.	non-wooded	0.30

The designer should also be aware that the VDOT Drainage Manual is also available for additional reference. However, Chesterfield County reserves the right to make the final determination of "C" factors used.

The Environmental Engineer may allow for a variation of the given standards where the effect of such variation is in keeping with established professional engineering practices and procedures. This variation may be used for modification of a standard, but not for the modification of a policy or requirement from the Federal or State government.

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FORMAT FOR PLAN SUBMISSION

Subdivision Development: Plans for roads, drainage and erosion control shall be submitted to the office of the Environmental Engineer for all proposed projects where roads are to be taken into the State Secondary System (5 sets, to include sewer and water line profiles).

Site Development: Plans for roads, drainage and erosion control shall be submitted to the Planning office for all proposed projects that are considered sites by the Planning Department (3 sets; 2 sets will be sent to Environmental Engineering).

Land Disturbing Activity: Plans not associated with a site or subdivision but indicate borrow, filling, grading or proposed vegetative disturbance which are not exempt from the current Erosion Control Ordinance must be submitted to the Planning Department (6 sets; 4 sets will be sent to Environmental Engineering).

Program Administration Fee - shall accompany the initial plans submission.

The following information (where applicable) is to be provided or considered on all plans submitted for review.

I. Sheet Size: Original plan sheets shall be of a permanent print (blue line) and be 24" x 36". At a minimum, borders shall be as follows:

- A. Right Side..... $\frac{3}{4}$ "
- B. Left Side.....1" to $\frac{3}{4}$ "
- C. Top and Bottom..... $\frac{1}{2}$ "

II. Cover Sheet: A cover sheet shall contain the following information:

- A. Subdivision name and section designation
- B. Magisterial District followed by "of Chesterfield County, Virginia"
- C. Zoning case number and Board approval date (provide copy)
- D. Planning Commission tentative approval date (provide copy)
- E. Name of Developer/Owner, Address, Telephone Number
- F. Date
- G. Engineer or Surveyor, Address, Certification Stamp (insofar as allowed by State regulation laws), Telephone Number
- H. Vicinity Sketch (1" to 1000' scale) showing existing road names
- I. General construction notes
- J. Estimate of quantities (may be on detail sheet)

III. Plan Sheets

Construction plan sheet or sheets:

- A. Indicate all proposed and existing right-of-way boundaries, all lot lines and dimensions, all lots and block numbers, easements, all street names and existing State route numbers.
- B. Indicate centerline curve data for all streets including delta, radius, arc, chord, and tangent.
- C. Indicate center line stations at 100' intervals and at all other strategic points, i.e. curve, tangent, drainage structuring, utilities, etc. and intersection of streets.
- D. Indicate radius of all curb returns (to face of curb or to edge of pavement when curb and gutter is not required). Also, indicate radius for all turnarounds.
- E. Indicate width of proposed street pavement (or width between curb faces if curb and gutter is used) and width of right-of-way. Lightly shade all areas proposed to be paved.
- F. When proposed and existing streets intersect, indicate existing conditions for 600 feet in each direction. This is to include width of pavement, right-of-way, location and direction of roadside drainage, any culverts to include inverts, utilities, etc. .

- G. Indicate driveway entrance type, i.e. computed culvert size (10 year) or VDOT designation.
- H. Indicate all proposed and existing storm sewers, ditches, culverts and appurtenances and identify by type, size, length, material, inverts and designate a structure number for each.
- I. Indicate with arrows, the direction of flow in all gutters, storm sewers, ditches, subsurface drains, streams, minimum finished floors, etc. .
- J. Indicate inlet and outlet elevations of all appurtenances to include throat elevations and length.
- K. Indicate location of all springs and mines, and proposed treatment of same.
- L. Indicate all existing and proposed ditches and streams and any relocations showing longitudinal slope and furnish detailed typical section showing type of stabilization to be provided and maximum and minimum vertical depth.
- M. Indicate direction of North on each sheet and direction shall be consistent on all.
- N. Indicate location and type of guard rails, posts and traffic barricades.
- O. Indicate location and description of all benchmarks and their elevation referenced to mean sea level. At least one (1) benchmark must be shown within the limits of the subdivision.
- P. Indicate location of any County control monuments within vicinity.
- Q. Plans shall be to a scale of 1"=100' or 1"=50'.
- R. From the intersection of at least one proposed street, indicate the distance to the closest existing intersection.
- S. Any notes that may be necessary to explain the intent and purposes of the plans.
- T. Indicate the location and size of all proposed and existing sidewalks and walkways.
- U. For site development plans, proposed and existing topography should be shown on the construction plan sheets, i.e. proposed and existing contours, buildings (to include finished flood elevations), parking lots, walls, etc. When curb and gutter is used, top of curb elevations need to be shown at appropriate locations.
- V. Indicate proposed and existing lakes and ponds (NOTE: Separate detailed plans are to be submitted for all such structures).
- W. Site plans must be tied down so that site can be field located.
- X. Adjacent property owners and lot lines must be shown.
- Y. Easements must be stationered in such a manner as to coordinate with profiles.
- Z. Match lines must be shown with any overlap distinguished by dotting such overlap.
- AA. Cut and fill lines must be shown.
- BB. If phasing is desired, phasing must be shown on the plans.

IV. Profile Sheet

Profile Sheet or Sheets:

- A. Existing center line profiles and stations must be shown on all proposed streets, storm sewers, stream relocations outfall ditches (to existing streams, and on drainage ditches to include elevation of utility crossings).
- B. Additional profiles should be shown to the right and left of center line at the right-of-way line.
- C. The finished grade line of all streets must show and include:
 - 1. Percent of grade
 - 2. Elevations at beginning and end of all vertical curves, at the low point of vertical curves and at all catch basins.
 - 3. Length of all vertical curves
 - 4. Stations at the low point and at all points of intersections.
- D. Stations shown on profile must agree with stations shown on plan. Stations must progress in the same direction on both plan and profile.
- E. Show existing profiles 300 feet beyond construction limits of proposed roads that stub into adjacent properties.
- F. Show profile of existing center line to the extent necessary to show that vertical and horizontal sight distance and grade is in compliance with VDOT standards on road profile.

- G. Show proposed culvert or storm sewer crossing at the proper location and grade, as well as sanitary sewer and water crossings.
- H. Each system should be shown in its entirety to include, as a minimum, the following information:
 - 1. Percent of grade and length
 - 2. Size and material
 - 3. Show catch basins, inlets, etc. with proposed elevations for tops and inverts.
 - 4. Show existing and proposed ground surface over center line of system.
 - 5. Show hydraulic grade line backed up by calculations.
 - 6. Existing utilities passing perpendicular to the system or sharing a common easement (to include outer elevation)
- I. Open channels must include, as a minimum, the following:
 - 1. Percent of grade
 - 2. Center line profile
 - 3. Existing ground profiles at center line and easement edge
 - 4. Typical section showing 10 year design depth, velocity and pertinent hydraulic data

V. Detail Sheet

Detail Sheet or Sheets:

- A. Show details of all proposed structures for which there is no standard drawing or modifications of standards. Examples would be special drop inlets, channel cross-sections, typical road cross-sections, erosion control devices, etc.
- B. If a VDOT standard is modified, detail must be shown.
- C. List all construction notes necessary to complete the work.
- D. Number assigned to structure shall be shown with detail.

VI. Topographic Sheets

General Topographic and Layout Sheet or Sheets:

- A. Show existing contours (maximum of five foot interval) to mean sea level datum (or lesser interval where deemed necessary by County).
- B. Show proposed and existing road right-of-way with road lanes, layout, property and lot lines; office, industrial, apartment and commercial buildings must show finished floor elevations, parking lots, etc. (1"=50' or 100').
- C. Indicate schematically, all proposed and existing drainage structures, channels, etc. showing structure numbers.
- D. Indicate limits of drainage areas and the acreage of each area. When the off-site drainage area becomes larger than one hundred (100) acres, the limits of the area may be shown on a larger scale map (maximum 1"=2000') with a larger contour interval (maximum 10'). All drainage area maps must be scaled maps which are completely contoured with contour elevations and part of the actual plan assembly.
- E. Indicate limits of computed flood plains and identify as to frequency of design storm.
- F. Drainage computations may be shown on or attached using standard forms.
- G. Use arrows to indicate direction of flow on all roads, ditches, pipes, etc.
- H. Show on contour map, the stations and lot numbers.
- I. Traffic counts and analysis. Master plan of all proposed sections and or/phases. The master plan must depict traffic patterns and vehicles per day counts. On any road that is proposed to extend into another subdivision or vacant parcel, a traffic analysis is required. The analysis must contain an overall plan of adjacent property and computations indicating how vehicles per day projections were arrived.

- J. One additional and separate master plan sheet showing traffic patterns, vehicle per day counts, and street- light locations, as per the streetlight policy, must accompany the initial submission. Additional street- lights, beyond those required by policy, which may be desired by the developer/owner may also be shown on this sheet. **NOTE:** *Streetlights must be shown for private road subdivisions and must conform, as a minimum, to the Streetlight Policy. Their installation, however, is the responsibility of the developer, i.e. the County will not coordinate their installation with Virginia Power and will not assume responsibility for monthly service charges.*

VII. Erosion Control (see appropriate section)

VIII. Sequence of Assembly

- A. Subdivisions:
1. Cover Sheet
 2. Drainage areas to show all on-site and off-site drainage that are pertinent to the subdivision in question.
 3. Plan view of the subdivision by either sections or overall showing all pertinent information with the topography to the appropriate scale so that lot drainage may be evaluated.
 4. Profiles for the roads
 5. Items 3 and 4 may be on split sheets
 6. Profiles for all drainage improvements, i.e. storm sewer, earthen channels, paved ditches or natural watercourses, sanitary sewers if required. All profiles of one system should be shown in its entirety as one system and not located on several different sheets. The hydraulic grade line must be shown for the complete system.
 7. Drainage computations, if shown on marked sheets, rather than small, individual sheets.
 8. Erosion control sheets
 9. Detail sheets showing miscellaneous details that will be required.
 10. Any special details as to drainage, roads, special grading, etc. .
- B. Sites: Site plan information can be shown on one sheet (see Planning Department plan submittal list), but must include all appropriate information as outlined in the manual.

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**CHESTERFIELD COUNTY ENVIRONMENTAL ENGINEERING
PLAN SUBMITTAL CHECKLIST FOR SUBDIVISIONS**

**SEE APPENDIX C, PAGE 172
FOR REVISED CHECKLIST FORMAT**

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**CHESTERFIELD COUNTY ENVIRONMENTAL ENGINEERING
PLAN SUBMITTAL CHECKLIST FOR SUBDIVISIONS**

**SEE APPENDIX C, PAGE 172
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ROADS AND RIGHT OF WAY

I. Right-of-Way, in most cases, shall mean that portion of a subdivision plat or area shown on a deed of dedication plat whose ownership is being transferred from one owner to the County of Chesterfield as a prerequisite to becoming a State maintained public access.

A. Essentially, dedications of rights-of-way fall into four general categories. These categories and their respective procedures for acceptance are as follows:

1. **Road Widening Strips** - will be processed through the deed of dedication process, initiated by the Utilities Department Right-of-Way Section. Plats will be routed to appropriate departments for approval prior to being presented to the Board of Supervisors.
2. **Subdivisions** - Plats will show all roads to be constructed during development of the subdivision. Detailed road and drainage plans must be submitted and approved and appropriate construction bonds posted prior to plat recordation.
 - a. Tentative and record plats may show rights- of-way to be dedicated for future roads provided such roads are in accordance with the adopted Transportation Plan.
 - b. The Director of Transportation will exercise approval authority as to location and right- of-way width for future roads.
 - 1.) Submission and approval of road and drainage plans and posting of construction bonds are required for the dedication of rights-of-way for **future roads** through recordation of a subdivision.
3. **Sites** - Site plans will show all new public roads to be constructed in conjunction with the development of office, commercial, industrial, or public complexes. Detailed road and drainage plans must be submitted and approved as a facet of the site plan approval process. Conditions of site plan approval include the posting of appropriate road construction bonds. Upon site plan approval, right(s)-of-way will be dedicated through the deed of dedication process.
 - a. Right(s)-of-way for future roads may be shown on site plans in accordance with I., A., 2., a and b above.
4. **Substantial accord** - Roads as noted above or to be constructed by VDOT do not require approval under the substantial accord process.
 - a. All other road construction requires that the Planning Commission find that such construction and its location are substantially in accordance with the Chesterfield County Comprehensive Plan prior to dedication of the right-of-way.

II. The County of Chesterfield shall not enter into a transfer of ownership until it has certain guarantees:

- A. The Virginia Department of Transportation must, in writing, indicate to the Environmental Engineer that it has reviewed and approved the construction plans for the roads as meeting their criteria. When final inspection determines construction in compliance with the approved plans, they will take the roads into the State's Secondary Road Maintenance System.
- B. The Environmental Engineering Department has determined that County drainage and erosion control requirements have been met.

- C. The proposed right of way connects to other existing right-of-way ultimately connected to a State maintained road.
- D. The County of Chesterfield has a sufficient third party surety approved by the Chesterfield County Attorney to cover the cost and to guarantee the completion to state and county standards of road and drainage construction through the full extent of the right-of-way being dedicated. The exception to this is rights - of - way parallel to existing state roads and stub roads (see V.B., this section)
- E. All items have been completed for the final check plat.
- F. The proposed right-of-way provides the minimum required frontage to all lots being subdivided on temporary cul-de-sacs.
- G. The proposed public road must have received schematic, tentative, and/or final check approvals by the Secretary to the Chesterfield County Planning Commission, the Planning Department, and the Engineering Department prior to recordation.

III. The County of Chesterfield acts only as a temporary vehicle by which the private developer obtains a State maintenance take-over of the roads he builds. It is the responsibility of the Environmental Engineering Department to insure that all rights-of-way dedicated to the County contain roads which will ultimately achieve State maintenance.

- A. If construction of the road through the full length of the right-of-way being dedicated requires an off-site drainage easement which has been documented as unobtainable, the Environmental Engineer has the discretion to approve road construction only up to a point where the constructed road would meet GC-7 criteria. This assumes the required right-of-way frontages for adjacent land development or lot recordation are still achieved.
- B. The right-of-way from the drainage break to the property line shall be recorded, however, there will be no vegetative disturbance or required bonding as State maintenance will be sought only for the portion of the right-of-way being constructed.
- C. Temporary turnarounds shall be fully paved in accordance with the Chesterfield County subdivision ordinance and shall have a pavement design commensurate with that established by projected traffic counts when the road is extended.
- D. Temporary turnarounds are required when the road right-of-way stub provides frontage to at least two lots on either side of the right-of-way.
- E. No right-of-way shall be recorded by subdivision plat or deed of dedication without prior approval of the Environmental Engineer.

IV. Right-of-Way for Stub Roads

- A. Right-of-way stubs are located within recorded subdivisions (usually parallel to lot side property lines) strictly to provide routes of access into future off-site development areas. They provide no required frontage for the lots in the subdivision and shall not necessarily require corresponding road construction within, as in all other cases.
- B. Stub roads into future developing areas owned by the same developer shall not be dedicated as rights-of-way but shall remain as fifty (50') feet strips contiguous with the land area and ownership of the future development area.

- C. Slope easements, as necessary, shall be dedicated on the adjacent lots.
- D. Where future access (stub road) for an adjacent landowner's property is required, right-of-way shall be dedicated to the county. A fully approved road and drainage design establishing feasibility and slope easements is required a minimum of three hundred (300') feet into the adjacent property. No third party surety is required as the actual construction of the road shall be the responsibility of the future developer of the property into which the stub connects.
- E. The future developer is required to provide all existing entrances utilizing the undeveloped public right-of-way he is upgrading with state and county minimum standard entrance conditions (e.g. adequate length/size concrete culvert).
- F. The future developer is responsible for making application of the vacation of surplus road stub right-of-way.
- G. If drainage needs to utilize future stubs, the improvements shall be installed in its ultimate location.

V. Additional Right-of-Way Strips

- A. When a subdivision is recorded adjacent to, and contiguous with, an existing State maintained road whose right-of-way width is less than that which is ultimately called for, the widening of that right-of-way is accomplished through the dedication of "strips" of a width as specified by the County Transportation Department and/or VDOT.
 - 1. The additional rights-of-way created by this strip establishes the property line of adjacent lots and the beginning of any required buffers unless there is vegetative disturbance required in the road construction which would extend the limits of construction beyond the strip limits. In that case the buffer shall begin at the limits of construction, unless otherwise approved by the Planning Department.
- B. When, as terms for getting the roads in the new subdivision into the State system, the developer is required to implement road widening and/or transitions or turn lanes within these strips, the cost of implementing such improvements to the existing State maintained road shall be considered part of the subdivision development costs and, as such, unless the developer can produce a valid VDOT permit for the work, costs of implementing these rights-of-way improvements shall be included in the cost estimates establishing the required county subdivision bond amounts.
- C. Additional "right-of-way strips" shall not be referred to as "widening strips" on the recordation plat.

VI. Right-of-Way Easements

- A. Areas designated as right-of-way for high voltage transmission lines, natural gas etc. are, in most cases, actually easements. All existing right-of-way easements shall be shown on subdivision plans, recordation plats, or, as applicable, on deeds of dedication plats. A prior rights relinquishment to the County by the holder of the easement through the execution of a quit claim deed will be required in certain locations where the right-of-way easement conflicts with a public right-of-way or easement.
- B. Right-of-way easements (ingress-egress easements) shall also be used in private road subdivisions. The easement widths and geometry shall be identical to County dedicated right-of-way except that it will be portrayed as a dotted line encompassing portions of adjacent lots whose common property lines form the center line of the right-of-way easement and shall be dedicated in favor of the owner, his successors, or assigns.

VII. Road Name Criteria (See House Numbering Ordinance section)

VIII. Engineering Criteria Pertaining to the Right of Way - The commonly used term of "road and drainage plans" should more appropriately be replaced by the term "subdivision construction plans". When the County has judged there to be no adequate available lot drainage provisions, it shall require that the rights- of-way perform a drainage function by providing road center line profiles which are in a minimum one (1') foot cut and which provide at least a one percent gradient between the lowest ground elevation on the adjacent lot and the roadside ditch or top of curb within the right-of-way (flat areas).

- A. The Chesterfield County standard road slope tie-in to existing ground for both road cut and fill sections shall be 3:1.
 - 1. The construction plans shall portray the road limits of construction that exceed the 3:1 slope standard. Slopes so exceeding the 3:1 slope standard must be justified to and approved by the Engineering Department.
- B. State acceptance of roads shall occur only after all county items have been satisfactorily addressed and shall be on a per subdivision section basis.
- C. The entirety of every road and lot to be recorded shall be shown on the plan sheets of the sub-construction plans. All information on the sub-construction plans shall coincide with the subdivision plat and vice versa.
- D. Curb and gutter, sidewalks, medians, etc., will be portrayed symbolically on the 1"-50' plan view of roads.
- E. The right-of-way width and state route number as applicable shall be provided on the construction plans on all roads that are contiguous with the project.
- F. Road center lines and outfall easements will be staked in the field prior to County plan review.
- G. Numeric road stationing shall be provided at one hundred (100') feet intervals on all plan, profile and topographic views of the road.
- H. All existing or proposed drainage structures in, immediately adjacent to, or otherwise affecting the road, shall be shown in plan, profile and topographic views. Stationing and material type will be required on the plan view. Invert elevations shall be shown on plan and profile views.
- I. All County control monuments along proposed frontage shall be shown.
- J. Storm drainage shall not be allowed to flow from rights-of-way into unauthorized locations.
 - 1. The points of storm drainage outfall from rights- of-way must be designed to 10-year criteria and connect to a drainage easement or to an adequate natural water course as approved by the Environmental Engineer.
 - a. The utilization of ground above an outfall storm sewer is an unauthorized location for storms of a 10-year magnitude and less.

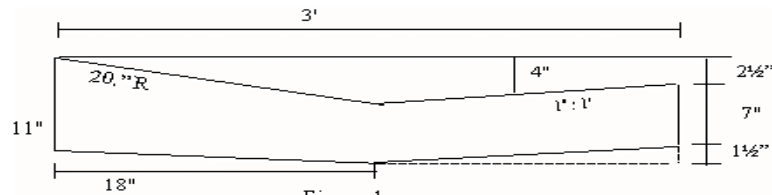


Figure 1
Roll Face Curb & Gutter

K. Curb and gutter specifications:

1. If CG-6 is used, driveway aprons must be poured at all entrances prior to state road acceptance.
2. If rollface curb and gutter is used it must be constructed as portrayed in Figure 1.
 - a. In cul-de-sacs draining into the bulb, a three (3) drop inlet combination must be used as illustrated in Figure 2 and must include a ten (10) foot transition to CG-6 with each apron as shown in Figure 3.

K. All roads shall have a minimum two (2) inches S-5 or a combination of S-5 and B-3 or I-2.

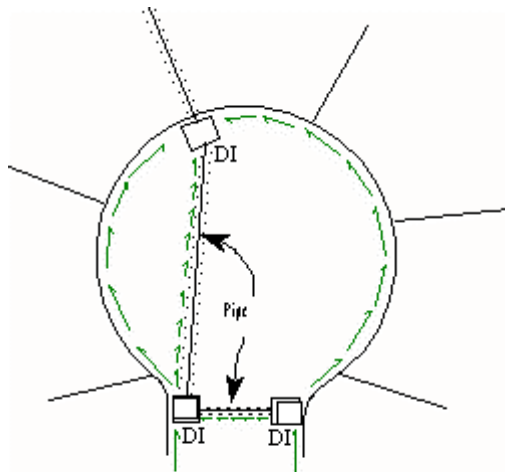


figure 2

3 Drop Inlet Combination for Cul-de-Sac

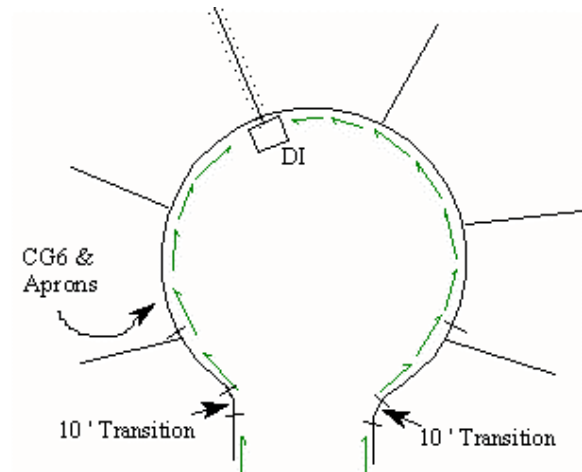


figure 3

10 foot Transition to CG6

IX. **Roadside ditch criteria** - The Virginia Department of Transportation (VDOT) is the final authority on roadside ditches within rights-of-way to be taken over by the State for maintenance; however, the same erosion and sediment control requirements that pertain to all other open ditches apply to roadside ditches as well, i.e. a condition which allows the ditch or back slopes to become a source of downstream siltation is unacceptable and must be corrected.

- A. The profile information on roadside ditches will be taken from the standard relationship between roadside ditch flow line and road center line as established by the roadway typical section. Only in those locations where this relationship is altered, such as when a roadside ditch slopes down to a culvert, or around a cul-de-sac, shall the roadside ditch profiles and percent of grade be indicated on the plans.
 1. Spot elevations at a maximum of twenty (20') feet intervals around the proposed cul-de-sac ditch flow line or along the top of curb are a suitable alternative in providing the contractor the necessary information to assure that the cul-de-sac can be built to drain
 2. The profile of an independently graded roadside ditch shall be shown.

- B. Road profile comparisons to existing ground should indicate an ability to acquire a minimum eighteen (18") inches roadside ditch depth or whatever depth is needed to allow designed entrance culverts to flow at design capacity.
- C. Roadside ditches may outfall only at specified locations which have been designated as natural water courses or which are contained by an easement.
- D. When an examination of a road fill design indicates toe ditches are inappropriate or an inability to contain the design storm or that the surcharge of a 100-year storm would cause water to outfall at an undesired location, "special roadside ditch back slope berms" shall be specified, designed according to the needs of the situation, and location and dimensions indicated on the plans.
 - 1. The minimum special roadside ditch back slope berm shall provide eighteen (18") inches of containment depth, be two (2') feet wide at the top of berm, and a slope back to original ground at 3:1. (See Figure 4)

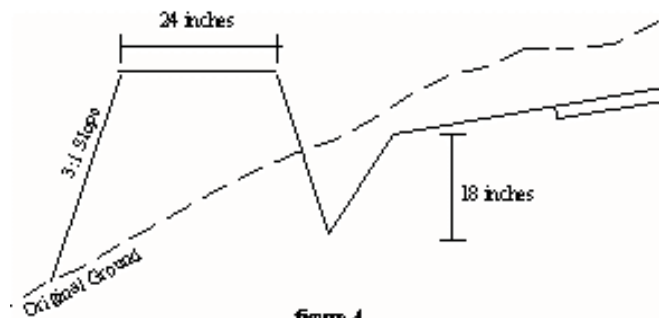


figure 4
Special Roadside Ditch Back Slope Berm

- 2. The location within the right-of-way where this provision is to be implemented shall be stationed and portrayed on the plan view of the construction plans.
 - 3. Particular care should be exercised in those locations where topography slopes towards the road to see that the special berm does not interrupt the natural flow patterns causing water to back up on the property adjacent to the right – of – way.
 - 4. Care should also be exercised when the ground slopes steeply away from the road that the containment berms are not constructed in such a way as to cause vehicles to "bottom out" as they exit of the right-of-way.
- E. Paving of roadside ditches is governed by ditch grades of .75% and flatter and/or velocities in excess of 3.5 fps.
- F. The roadside ditches within the rights-of-way shall have adequate depth to keep water from spilling over into adjacent lots.
 - 1. Special lot grading plans will be a required part of the construction plans where spillovers would occur on storms larger than the 10-year (100-year storm containment is, therefore, recommended).
- G. The paved transition section into an outfall at the end of a cul-de-sac shall be extended to a point of tie-in with the invert out of the last entrance culvert if less than ten (10') feet.
- H. The maximum entrance culvert diameter in a cul-de-sac bulb shall be eighteen (18") inches.
 - 1. When design discharges require pipe diameters of greater than eighteen (18") inches, storm water will be picked up at the reverse curve of the cul-de-sac bulb and conveyed via pipe under the pavement directly to the outfall. The private entrance immediately downstream of this pick-up point may have no entrance culvert.

I. Paved ditch depth around the cul-de-sac bulb shall be equal to the entrance culvert pipe diameter.

IX. Private Citizen Use of Dedicated Right-of-Way - Any use of County right-of-way (stub roads) or easements would require the requestor to obtain a license from the right-of-way Division of the Utilities Department. In general, Environmental Engineering would approve such use if:

- A. Adequate pipes are installed after obtaining a permit from VDOT if it fronts a State maintained road.
- B. The grade differential would meet the criteria so as vehicles would not "bottom out" if vehicle access was the intended purpose.
- C. There is no adverse affect on surrounding lots as to drainage.

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CHESTERFIELD COUNTY FLOOD PLAIN MANAGEMENT

I. Informational

- A. United States Army Corps of Engineers (hereinafter referred to as the Corps) flood plains, prepared for the Federal Emergency Management Agency (FEMA) as a part of the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973, have been established for 49 major creeks and streams in Chesterfield County plus the James and Appomattox Rivers (see lists below).
- B. The most recent Corps flood plain studies, completed in July 1980, were done to upgrade the Federal Flood Insurance Program in the County from the emergency program to the regular program along with the establishment of the Chesterfield County Flood Plain Management Ordinance approved by the Board of Supervisors in February 1983.
- C. The Corps/FEMA (detailed study methods) flood plains, on file in the office of Chesterfield County Environmental Engineering and available from the Customer Service Center of the National Flood Insurance Program in Lanham, Maryland (1-800-638-6620) shall take precedence over all other flood plain information. Any variance in the flood plain procedures as discussed in this Chapter must come through the official authorization of the FEMA.
- D. In referring to the Federal Flood Insurance Study or the Flood Plain Ordinance, the minimum flood plain limits which shall be of concern in this manual are those which are referred to as the base flood (100 year or 1% storm). Also, all other flood plains not established by the Corps/FEMA study are referred to as approximate* flood plain districts because they do not delineate the floodway and flood fringe within the flood plain.

II. Clarification Between Corps of Engineers Detail Study Flood Plains and Corps of Engineers Approximate Flood Plain Districts.

- A. Detailed Study Flood Plains - The 17 largest/most subject to adjacent development creeks in the County plus the James and Appomattox Rivers were given in depth detailed flood studies using the Corps of Engineers HEC-2 Step/Backwater Computer Program. The results of that study are shown in the flood boundary and floodway maps accompanied by the flood insurance study booklet, which provides flood plain cross-sectional and profile information.

This system of flood plains is a basic storm water management tool used by the County. It provides for reasonable use by non-residential development through delineation of flood fringe areas from floodway areas and establishes procedures for increases in flood elevations, sometimes necessary to accommodate any type of development. Private engineers are able to use this information as a framework for their development adjacent to these major creeks and, at the same time, provide reliable flood protection for their clients as well as any off-site landowners.

- B. Corps of Engineers/FEMA Approximate Flood Plain Districts - The remaining 32 creeks, as shown below, have their flood plains portrayed on a FIRM (Flood Insurance Rate Map). These maps portray the flood plains as darkened areas to each side of a line representing the main flow channel. No elevations, cross-sections, or profiles are provided. These maps are used for flood insurance purposes only, whereby a determination of an existing building being in a flood plain will be made by scaling the distance the darkened area extends out from the center line channel and then measuring that distance in the field. Any proposed building (residential or non-residential) in the vicinity of a Corps/FEMA approximate flood plain district would require a detailed flood study and field location by a professional engineer to insure its location outside of the base flood plain prior to release of a building permit.

(*Not necessarily indicative of the engineering).

For the purposes of development in Chesterfield County, these maps shall only serve to provide the awareness of there being a significant flood plain which must be engineered with the development of the adjacent property. In other words, these areas are treated with the same approach as streams with no Corps of Engineers studies except that the horizontal limits of the flood plain established by the project engineer shall not be less than the scaled widths of the approximate flood plain as shown on the flood Insurance Rate Map without permission from FEMA.

Proposed encroachment for non-residential development in Corps of Engineers approximate flood plain districts could be to the extent of a floodway as established by the private engineer for the project.

There is no limitation on the amount of the approximate flood elevation increase from road crossings as long as any affected landowners are dealt with as discussed in this Chapter.

E. Creeks in Chesterfield County on which the Corps/FEMA detailed flood plains have been established:

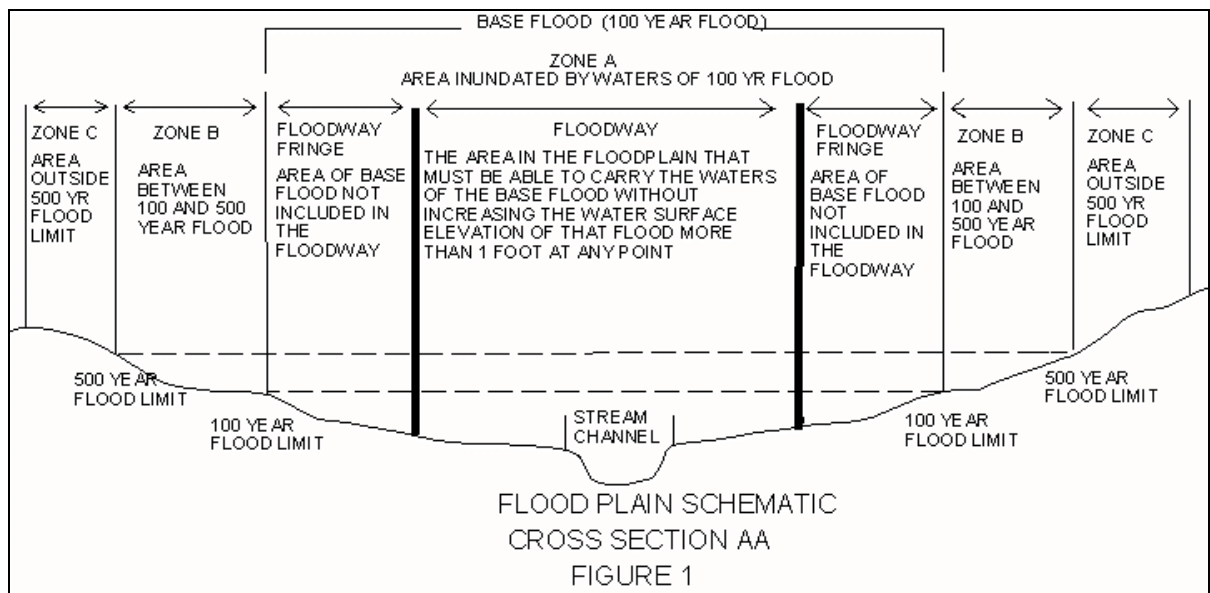
- | | |
|--------------------------|---------------------|
| 1. Ashton Creek | 10. Nuttree Creek |
| 2. Crooked Branch | 11. Old Town Creek |
| 3. Falling Creek | 12. Pocoshock Creek |
| 4. Great Branch | 13. Proctors Creek |
| 5. Hamlin Creek | 14. Redwater Creek |
| 6. Johnson Creek | 15. Swift Creek |
| 7. Kingsland Creek | 16. Timsberry Creek |
| 8. Licking Creek | 17. Tomahawk Creek |
| 9. Little Tomahawk Creek | |

F. Creeks in Chesterfield County on which the Corps/FEMA **approximate flood plain districts** have been established:

- | | |
|-----------------------|---------------------------|
| 1. Beach Branch | 17. Nooning Creek |
| 2. Big Branch | 18. Otterdale Branch |
| 3. Blackman Creek | 19. Powwhite Creek |
| 4. Branch Branch | 20. Reedy Creek |
| 5. Carvers Branch | 21. Rita Branch |
| 6. Cattle Creek | 22. Rocky Run |
| 7. Deep Creek | 23. Sappony Creek |
| 8. East Sappony Creek | 24. Second Branch |
| 9. First Branch | 25. Skinquarter Creek |
| 10. Franks Branch | 26. Spring Run Creek |
| 11. Goody Branch | 27. Surline Branch |
| 12. Grindall Creek | 28. Swift Creek Reservoir |
| 13. Horners Run | 29. Third Branch |
| 14. Horsepen Creek | 30. Turkey Creek |
| 15. Mann Branch | 31. West Branch |
| 16. Michaux Creek | 32. Winterpock Branch |

III. General

- A. This section must be used in concert with the Chesapeake Bay Ordinance with the most restrictive requirements prevailing.
- B. A 100 year flood plain is made up of two areas, the floodway and the floodway fringe as defined in Article III, Division 3 of the Chesterfield County Zoning Ordinance. See figures 1, next page, and 2, on the following page.



- C. Flood discharges are generated on the basis of an assumption of total upstream development following that shown on the most current Chesterfield County Land Use and Transportation Plan or; in accordance with recent rezoning and/or development trends in the watershed which may have higher stormwater run-off potential than would be indicated by the land use plan.
- D. All development in relation to the flood plain management ordinance is considered as either residential or non-residential.
- E. The Flood Plain Ordinance is a division of the Chesterfield County Zoning Ordinance which requires a minimum 20' distance from the 100 year flood plain and the house in residential zones.
- F. For the purpose of this manual and as a general applied nomenclature, the term "100 year stormwater limits" shall refer to the 100 year flood plain or flood plains where the contributing drainage area is less than 50 acres.
- G. Drainage areas greater than 50 acres will use the nomenclature "100 year flood plain".

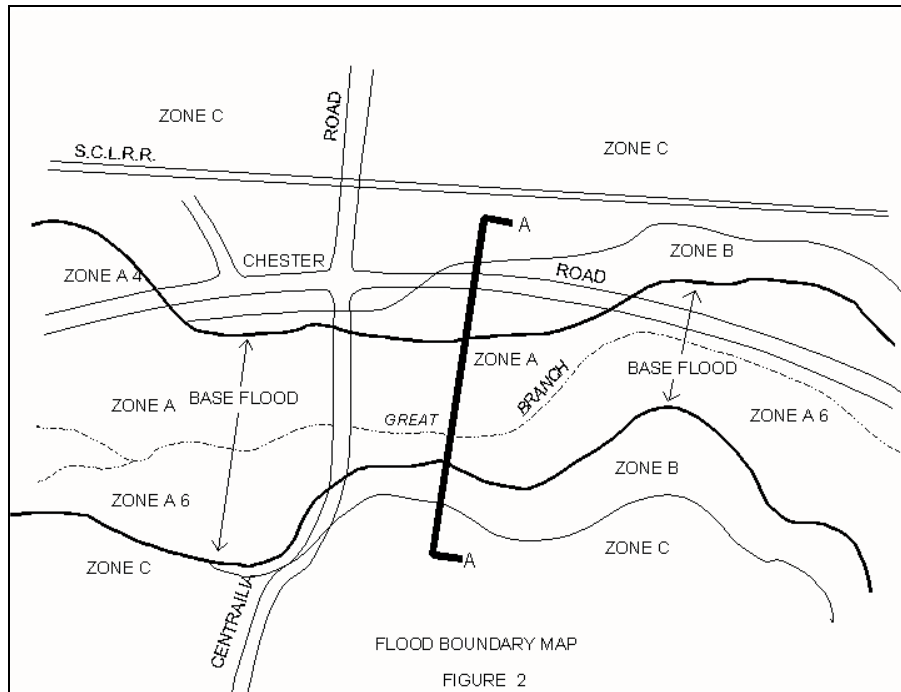
IV. Procedure for Delineation of Floodway from Floodway Fringe

- A. On creeks covered by the U.S. Army Corps of Engineers/ FEMA detailed flood plains the delineation has already been made. The information is available in the flood insurance study booklet and can also be viewed on topography sheets in the Environmental Engineering Department.
- B. On all other creeks (non-residential), the unencumbered 100 year flood plain limits shall first be established. Then by trial and error, a series of vertical blockages shall be extended into the flood plain cross-section at equal distances from the outside edges of the flood plain. The distance into the flood plain that the vertical blockage must extend to reduce the theoretical cross-sectional area to the point of raising the base flood level 1 foot shall establish the boundary of the floodway from the flood fringe. The overall flood plain elevation would now be considered to be 1 foot higher than originally figured.

V. Flood Plain Management

- A. Subdivisions located adjacent to stormwater limits shall contain sufficient land area outside of the flood plain under existing natural conditions to reasonably allow dwellings to be constructed thereon, allow reasonable use of the lots, and to adhere to required zoning restrictions pertaining to the 100-year storm- water limits. (Compare to Chesapeake Bay, as most restrictive condition would apply.)

1. The required delineation of stormwater limits is a development management tool designed to show where homes can be safely located.



2. All drainage courses within and adjacent to subdivisions shall have stormwater limit delineations except where the 100-year storm remains within the limits of an easement or does not exceed the banks of an adequate natural watercourse.
- B. Houses built in residential developments can be located at a distance of no less than twenty feet from the 100-year stormwater limit and have a lowest floor elevation, to include basement, no less than one foot above that stormwater limit elevation.
1. Lots shall have a building setback recorded on the subdivision plat 20 feet from the 100-year storm- water limits, unless RPA limits exceed the flood plain by 20 ± feet (no mixing per subdivision section).
2. The area within the twenty feet between house and stormwater limit shall exhibit adequately dry conditions for reasonable use.
- C. Structures without floodproofing in non-residential developments shall be built with a lowest floor elevation of no less than 1 foot above a floodway elevation and shall not encroach into the floodway.

- D. Stormwater limits, legally established by subdivision plat which encompass areas greater than that of the Corps/FEMA flood plains shall take precedence in establishing the County's storm water management concerns and the Flood Plain Management Ordinance requirements.
- E. Building structures located immediately downstream of a dam shall have the one foot vertical and twenty foot horizontal criterion based on the limits of inundation occurring from a dam failure during the 100-year storm.

VI. Filling in the Flood Plain

- A. Residential Development: Under most circumstances filling (exclusive of roads) in the 100-year stormwater limit or backwater will not be permitted to create a buildable lot.
- B. Non-residential Development: If the area is not a wetland or subject to Chesapeake Bay Regulations, minor filling shall be permitted in the floodway fringe.
 - 1. Filling in the floodway fringe.
 - a. When filling is proposed in an approximate stormwater limit floodway fringe, an upstream analysis shall be made to determine the extent of the stormwater limit increase. Any stormwater limit elevation increase on off-site property must be legally permitted by the affected landowner prior to the Environmental Engineer's approval.
 - b. Any filling proposed for detailed study Corps of Engineers/FEMA established floodway fringes shall be assumed to precipitate the floodway elevation. If the additional area of inundation affects an upstream landowner, easements must be acquired.
 - c. Any filling which proposes an increase in a Corps/FEMA detailed study flood plain elevation greater than the published flood elevation as listed in the FEMA flood insurance study booklet shall require a letter of map revision (LOMR) from FEMA.
 - d. Even though encroachment is allowed in non- residential cases, filling should be kept to a minimum.

FLOOD PLAINS

The term "100-year stormwater limit" shall refer to any area which is theoretically inundated by stormwater from a storm of the applicable 100-year frequency, duration and intensity.

- I. Natural State Flood Plains** - May be used only in R-40 and above zonings (single family lots of 40,000 square feet or more) and commercial areas regardless of size.
- A. Natural state flood plains are defined as areas of highwater table, flat slopes, poorly-drained swampy conditions and indigenous vegetation adjacent to one or more low-flow channels (sometimes coincidental with wetlands). The extent of the flood plain shall cover the entirety of these conditions but at a minimum is established by the calculated limits of inundation by the stormwater runoff from a storm whose magnitude statistically has a one percent chance of occurring in any one year (100 year storm).
 - B. The term "natural state flood plain" shall refer to a 100 year storm for minimum required protection, but in cases where beneficial, is allowed to be wider. It may or may not include an identifiable wetland.
 - C. An adequate natural state flood plain shall remain in its natural state. The main emphasis shall be the provision of adequate stabilization as opposed to specified channelized containment.
 - 1. When possible, in "natural state flood plains", channelized containment from outfalls is gradually reduced, then totally eliminated in keeping with a concept of avoiding new man-made points of channelized entry into existing creeks.
 - 2. Any poorly-drained conditions which are contiguous with a calculated 100-year flood plains which can be brought within the limits of a designated natural state flood plain may remain as such.
 - 3. Wet, swampy, undrained conditions beyond the limits of any designed flood plain are unacceptable and shall be alleviated for the purposes of lot development, unless prohibited by any other local ordinance, Federal, or State regulation.
 - 4. Reaching an adequate "natural state flood plain" with adequate man made or naturally provided energy dissipation will be the required extent of the easement.
 - D. Some limited clearing of flood plains is unavoidable as in sanitary sewer line construction, construction of facilities in drainage easements and creek improvements. These man made disturbances do not necessarily disqualify an area from being designated as a natural state flood plain. Based on the scope of the disturbance in relation to the remaining undisturbed area, the Environmental Engineer shall make the determination.
 - E. The concept of the natural state requires certain restrictions and design procedures. Some basic premises of natural state design:
 - 1. Underground utilities (public or private) which do not require gravity for their operation shall not be placed in natural state flood plains.
 - 2. Storm drainage outlets shall discharge into the adequate flood plain in a manner least likely to cause erosion. When an adequate flood plain is available, the channelized outfall facilities shall discharge onto it, utilizing design methods which will convert to sheet flow rather than disturb the flood plain vegetation by extending a man made improvement to a central channel.
 - 3. No filling or excavation is allowed in residential natural state flood plains or non-residential floodways.

II. Adequacy Determinations of Natural State Flood Plains

- A. The County recognizes that whenever the balance established by nature between a watershed and its naturally stabilized drainage ways is disturbed, some corrective measures may have to be taken to restore this balance and avoid downstream flooding and erosion damage. Flood plain adequacy is established by such factors as:
1. Existing vegetation
 2. Water table
 3. Size, width and shape of flood plain
 4. Slopes
 5. Relationship to developing area
 6. Anticipated disturbance by utilities
 7. The volume and velocity of water being discharged
 8. The existing condition and cross-section of the stream within
 9. Soil characteristics pertaining to erosion
 10. Two (2) year storm velocities in the central channel based on ultimate upstream development
- A. If the flood plain is deemed not adequate in consideration of the above factors, the alternative shall be a more traditional design approach which may call for the construction of adequate drainage improvements directly into a stream bed and then the possible improvement of the stream itself down to the point of calculated adequacy.
- C. If the flood plain improvements are required, a standard easement covering these improvements to an adequate natural watercourse is required.
- D. Engineering design proposals for flood plain areas should result from good engineering judgement, consideration of the above listed factors, and the basic analysis procedure of natural channel adequacy as specified in the open channel portion of this manual and the Virginia Erosion and Sediment Control Handbook. However, the Environmental Engineer reserves the right and responsibility to make the final determination of the design approach to be used in flood plain areas since he is ultimately responsible for answering for those conditions in the flood plain to the citizens of Chesterfield County.
- E. The Environmental Engineer shall make the final determination as to when conditions are not such that an area can be considered a natural state flood plain.
- F. Flood plains on record prior to the inception of the natural state flood plain designation which exude the applicable characteristics as discussed herein, shall be considered to be "natural state flood plains."

III. Standard 100-Year Flood Plains

- A. All flood plains deemed other than "natural state" flood plains shall be delineated by the limits of a standard 100-year flood plain and may be referred to as the "100-year stormwater limits". This will be used to indicate, for example, the limits of inundation from a 100-year storm surcharging a 10 year design man made facility and shall also restrict non-utility development from within its limits.
1. This designation will not normally cover natural conditions nor have the flexibility allowed in a natural flood plain. Poor drainage is not an acceptable condition for a "100-year stormwater limit" and shall be remediated by the developer prior to state road acceptance even if approved construction plans make no provisions for this.

- B. Improvements shall be made to the streams and/or drainage ways within 100-year stormwater limits so that the increased runoff from development within the watershed can be accommodated without unacceptably elevating water surface levels or causing channel degradation.
 - 1. These improvements may be per State criterion on erosion control 2-year cross-section, case by case County Stormwater Management requirements, or may only necessitate the removal of obstructions, silt, and strategic rip-rap restabilization, etc.
- C. Requirements for the portion of the 100-year stormwater limit adjacent to the main channel may include:
 - 1. The removal of silt and debris which could clog or damage downstream drainage structures or property.
 - 2. The removal of dead trees or those that are judged soon to topple due to stream bank degradation.
 - 3. The filling or drainage of ponding areas and stagnant pools which are potential vermin shelters and mosquito breeding areas.
 - 4. Those sections of streams cut off by man-made improvements.
- D. The developer may opt to enhance the conditions on the lots by clearing and/or grubbing out undesirable vegetation within the stormwater limit. Acceptable conditions for an area of this nature shall be the same as required for non-flood plain areas and must be approved by Environmental Engineering.

IV. Engineering in the Establishment of Flood Plains

- A. The computation of stormwater limit areas is to be given consideration by licensed professionals who are skilled in and familiar with this particular type of engineering problem. The establishment of all storm- water limits shall be based on the balance of energy concept of computing water surface profiles. Storm- water limit calculations are to be submitted in an organized, reviewable form, with complete documentation for all computations used. Documentation shall include but not be limited to:
 - 1. Topography and drainage breaks of the contributing watershed on appropriate scale for drainage area;
 - 2. Profiles of the reach of stream in question;
 - 3. Adequate control cross-sections of the stream and any data concerning other constrictions or control points that may affect the flow;
 - 4. 100-year backwater elevations from any existing structures or creeks downstream;
 - 5. Runoff computations based on the appropriate hydrologic method;
 - 6. Water surface profile computations;
 - 7. Roughness coefficients for the cross-sections established based on the method as described in the natural channel section of the Virginia Erosion and Sediment Control Handbook.
- B. Stormwater limit determinations will be required in all locations where 100-year storm protection of a building or dwelling is in question regardless of the acreage of the contributing watershed.
- C. The 100-year storm shall be analyzed through all man-made drainage systems which are designed on a minimum 10-year storm basis to determine and show on the plan and plat the limits and route of the surcharge.
- D. The consultant's responsibility on Corps/FEMA (detailed study) flood plains will be to accurately locate the stormwater limit elevations in the field so that it may be properly portrayed on the plan and plat by distances off the front and/or back property corners of affected lots.

V. **Changes to Flood Plains** - A change to (or aggravation of) a stormwater limit connotes raising or lowering of that stormwater limit or an increase in the frequency of flooding.

A. Factors which would cause a change in a stormwater limit elevation would be:

1. Channel improvements.
2. Filling in the flood plain.
3. Siltation of the stream.
4. A diversion of a watershed.
5. The placement of an embankment across the flood plain.
6. Stormwater retention or detention.
7. Beavers

B. Where the 100-year stormwater limit analysis on existing cross-sections shows an inundation of land area that would place buildings in flooding jeopardy under the proposed layout, the developer may construct channel improvements so that the 100-year stormwater limit can be contained totally within the channel improvements or significantly reduced. The following requirements shall apply.

1. Adherence to the Article III, Division 3 of the Chesterfield County Zoning Ordinance "FLOODPLAIN DISTRICTS".
2. Adherence to the Chesterfield County Chesapeake Bay Ordinance.
3. If applicable, the developer will be responsible for obtaining the proper permits administered by the U.S. Army Corps of Engineers for the purpose of conformance with the P. 192-500, Section 404 Permit Program. A State of Virginia 401 permit may also be required.
4. The top of the channel improvements must be one foot higher than the calculated elevation for the 100-year stormwater limit being contained.
5. The improvement shall not have a detrimental effect on an adjacent landowner without his official and permanent permission running with the land (easement).
6. If the calculated stormwater limit limits are dependent upon the maintenance of the cross-section as constructed, a rigid self-cleaning (paved) lining must be provided in the channel in order to retain the desired cross-section and depth.
 - a. When rip-rap or grass-lined channel improvements on an existing natural drainage course are proposed to, for instance, provide stabilization, eliminate swampy conditions, provide drainage daylight, etc., the flood plain limits shall be established based on the existing natural cross sections prior to the improvements.
7. An increase in the stormwater limit elevation usually causes a corresponding loss of usable land. The County would approve no design or construction proposal which would have an increasing effect on any existing legally (e.g. recorded flood plain on subdivision plat) established flood plains or would approve no proposal which would potentially require regular County maintenance in order to perpetuate the limits of a legally established flood plain, or to decrease adjacent land not owned by the developer.
8. The County would approve no construction proposal which would cause certain undesirable stormwater limits to be reached on a more frequent basis, (e.g., scenario; an existing road floods on an average every five years. A proposal to fill in a portion of the culvert backwater would reduce detention storage area causing the road to theoretically flood once a year. The filling proposed would not be approved.

C. Filling in the Flood Plain or 100-year Stormwater Limit - Information Required for Plan Review.

1. Must not be in conflict with the Chesapeake Bay Ordinance.
2. The plan shall include a minimum of three control cross-sections:
 - a. upstream of the fill;
 - b. the most constrictive portion of the fill; and
 - c. one at a control point downstream of the fill.
3. The cross-section shall show the existing stormwater limit, a cross-hatched representation of the fill material placed on the existing cross-sections, and the resulting increased stormwater limit water surface and its elevation.
4. The fill plateau should have a minimum slope of one percent and the back slope tying into the original ground in the stormwater limit shall be a minimum of 3:1.
 - a. The portion of the backslope from 1' above the new base flood elevation shall be suitably stabilized with filter fabric and rip-rap, soil bio-engineering, or other provisions approved by the Environmental Engineer.
5. Where disturbance is less than 10,000 square feet and involves only one lot, the area to be filled may be cross-hatched on the plan view with drainage flow arrows indicating the desired drainage pattern of the finished condition. Where disturbance is greater than 10,000 square feet or involves more than one lot, a minimum two foot contour 1" to 20' portrayal of the desired filling configuration shall be provided.
 - a. This requirement applies to filling in non-flood plain areas as well.
6. When the initial establishment of stormwater limit limits or a revision to existing stormwater limit limits is accomplished through a filling and grading process, a certification from a licensed professional that the ground configuration in the field has been achieved which accurately reflects the stormwater limit limits as shown on the approved plan or subdivision plat is required prior to the release of any building permit.

D. Other factors which could affect stormwater limits.

1. Diversion of a Watershed - should not be confused with the rerouting of drainage via easements or rights-of-way of small drainage areas which ultimately end up in the same major stream. When, via man made improvements, an additional amount of drainage acreage beyond that which naturally drains to a particular stream generates enough additional runoff to have a measurable effect on raising an established stormwater limit or increasing a future stormwater limit establishment on someone else's property, this becomes a diversion and shall not be allowed.
2. Stormwater Detention - will not be a design alternative when it is determined that the increased peak time of the facility will actually aggravate the stormwater limit of the watershed stream it is a part of. This is usually the case in the middle and bottom third of a watershed.
3. Sedimentation - The sedimentation of a stream caused by the lack of proper temporary erosion and sediment controls or from accelerated stream degradation can have the effect of enlarging flood limits or creating flood limits where none previously existed because the 100-year storm discharges were contained within the channel banks. The Environmental Engineer may, through the Erosion and Sediment Control Ordinance, deem it necessary for the developer to enter even a Natural State Flood Plain to reacquire the necessary cross-section lost to the sediment in order to alleviate an existing or potential flooding.
4. Beavers - The dams built by beavers in flood plains can cause long term inundation of property that can meet or even exceed the recorded flood plain limits. Those affected by the backwater from the dam can get relief only if the owner of the property on which the

actual dam is located gives permission for the beavers to be trapped by a qualified trapper and for the County to enter the property for the purpose of dismantling the dam to the degree necessary for alleviation of the ponding. The department will perform this function a maximum of three instances, however, if the land owners make no attempt to contract with a trapper to have the beavers removed, after the third instance, the department will cease dismantling activities for the dam in question. The Environmental Engineering Department can provide the names of several qualified trappers, but the arrangements made for trapping are strictly between the trapper and the land-owner on whose property the dam exists.

VI. Backwaters - Backwaters are areas of allowable inundation of property immediately upstream of a road fill, limits of which are established by pipe size and height of the fill. Road embankments and their accompanying backwaters are major influences on flood plain elevations. But, unlike the process of filling in the flood plain which reduces storage areas depleting the naturally provided detention; backwater areas, particularly those which provide a non-topping capacity of the road embankment on a 100-year storm, serve to supplement the natural processes of detention and this concept is encouraged in Chesterfield County.

A. Backwaters as defined in Article III, Division 3 of the Chesterfield County Zoning Ordinance “FLOODPLAIN DISTRICTS”.

1. In Corps of Engineers/FEMA established (detailed study) flood plains, backwater limits coincide with those of the floodway, therefore no filling is permitted.
2. The backwater from any new road crossings cannot exceed the existing established Corps/FEMA flood- way elevations as shown on the floodway data sheets of the flood insurance study booklet if any other cross-sections are caused to have floodway elevations higher than a foot above the regulatory flood plain elevation. Otherwise up to 1 foot of flood plain elevation increase is allowed before a FEMA letter of map revision (LOMR) is required.

B. Where backwaters have been legally established by other means (e.g. subdivision plat recordation) no filling is permitted.

1. Increases in existing legally established back- water elevations are permitted for road projects if all affected land owners give legal permission (easements) and no violations of the Chesterfield County Flood Plain Management Ordinance are created.
2. Where no backwater or stormwater limits have been previously established, backwater elevation increases over the theoretical stormwater limits elevation are at the discretion of the developer or to the extent that he can gain legal permission when off-site properties are affected.
3. No filling within this backwater area for the purposes of gaining greater land area for residential construction shall be permitted.
4. Filling within a backwater established as part of a non-residential development is permitted on a one time initial basis, so long as the culvert size is established on a peak design procedure, the filling does not encroach into the original theoretical flood plain, and the man made shape of the flood plain is certified by a licensed surveyor or engineer.
5. Backwaters which will be created by the future construction of stub roads into adjacent property shall be determined and used to establish the stormwater limit limits for the property under development.
6. Future backwater determinations are not required for stub roads crossing streams which are covered by Corps of Engineers/FEMA detailed study flood plains.
7. The 1' vertical and 20' horizontal rule applies to buildings adjacent to backwaters.

C. Backwater/Stormwater Detention Easements - With a commitment of eventual Department of Highways takeover and the proper recorded use restrictions upstream of a road embankment, the

County would approve a culvert and backwater design which would establish the culvert size on the basis of the detention capabilities of the backwater area to the point where a 100-year storm would not top the road. This condition can occur quite frequently as in many cases high road fill elevations are established by other existing elevations which must be tied into by proper highway geometrics.

1. Backwaters will be based on a fully-developed upstream 100-year storm and the area of inundation upstream of each culvert shall be shown and tied down on the plan and record plat.
2. The maximum possible backwater elevation is established by the elevation of the lowest point in the sag of the road.
 - a. If the road sag elevation is already lower than the flood plain elevation, or the 100 year storm discharge requires a higher head elevation than that of the sag to be handled by the culvert, a stormwater limit rather than a backwater shall be considered to exist.
3. Normal backwater elevations are established by the head elevation (below the road sag) obtained when the peak 100-year storm discharge is analyzed through the culverts designed per some lower criterion.
 - a. If a peak design 100 year storm analysis indicates the road will be topped but flood routing procedures are then allowed to show backwater elevations below the road sag, the backwater limits will be contained by a stormwater detention easement encompassing the entire upstream volume up to the road sag elevation.
4. Backwater calculations must be provided for all culverts whose inundation could potentially affect private property. (See also Culverts Chapter)

VII. Minimum Floor Elevation Specification on Plans in Relation to Backwaters and Flood Plains

- A. Where a restriction of the flood plain such as a road embankment is higher than the 100-year water surface elevation, a minimum elevation of one foot above the lowest point in the embankment shall establish the minimum finished floor elevation, to include basement, for a dwelling on the lot and the structure located 20' outside of the backwater.
- B. When a 100-year storm culvert analysis of a road embankment shows a topping of the road, the minimum finished floor elevation will be established by adding a foot to the weir flow water surface elevation determined through the equation $Q = 3.03LH^{3/2}$, ($H = 2/3Y$) where Q is equal to the difference between the design Q100 and the culvert capacity at the maximum obtainable HW/D prior to topping the road. There are more refined procedures which are also permissible.
- C. When the minimum floor elevation necessary for sanitary sewer service is higher than the stormwater limit minimum floor, the sewer minimum floor shall take precedence. The plat and plan shall read, for example, "minimum floor elevation 100.00'" which does not stipulate whether it refers to sewer or flood. There should be only one minimum building elevation per lot prescribed.

VIII. Recordation of Flood Plains or 100-year Stormwater Limits and/or Backwaters

- A. Tentative plans shall be submitted showing the stormwater limits of all those established and on any streams whose upstream drainage acreage is 50 acres or greater.
- B. Approval by the Planning Commission of the tentative plan does not indicate County approval of the stormwater limit limits as shown on the tentative plan.

- C. Stormwater limits as shown on the recordation plat will be approved by the Environmental Engineering Department but in no way should that approval serve to exonerate the licensed professional engineer from any and all liabilities which could ensue.
 - 1. At time of formal submission of stormwater limit calculations with the construction plans, if stormwater limits are found to be inaccurate from what was presented on the tentative plan, the appropriate shifts shall take place.
- D. All areas which are inundated beyond the confines of designated channelization or easement by stormwater runoff from a 100-year storm are to be recorded as stormwater limits on the subdivision plat if contributing drainage acreage is under 50 acres.
- E. The stormwater limit shall be tied down appropriately to all affected property lines.
- F. In conjunction with Chesapeake Bay, if the RPA exceeds the 100-year flood plain by $20 \pm$ feet only the RPA must be shown on the recorded plat and tied down. (See Chesapeake Bay for additional information). The minimum finished floor must also be shown. Supporting flood plain/wetlands delineation, etc. must appear on the construction plans.
- G. A building minimum finished floor elevation for each lot affected by a stormwater limit or backwater shall be placed on the construction plans and subdivision plat.
- H. The backwaters of all culverts which exceed the limits of highway right of way shall be recorded on the recordation plat.
- I. "Natural state flood plains" shall be designated as such on the plat. All areas which are strictly natural state flood plains shall have an asterisk or other appropriate attention attractor on each affected lot which shall refer to a note on the plat making reference to the following: *"Natural State Flood Plains are to remain in their natural state and not disturbed under any circumstances without the direction of, or permission from the Chesterfield County Environmental Engineer. No maintenance of the area shall be performed by the County other than the removal of major blockages from the central stream, if in the opinion of the Environmental Engineer removal of the blockage is for the protection of homes from flood encroachment or to retard erosion."*

- IX. **Warning and Disclaimer of Liability** - It is the responsibility of a licensed professional engineer to calculate the flood plains in a professional manner and County approval of such limits is not intended to verify the accuracy of such flood plain or indemnify him from any liability if the flood plain limits are later determined to be inaccurate.

The degree of flood plain protection required by this manual is considered reasonable for regulatory purposes. Larger floods may occur on rare occasions or flood heights may be increased by man made or natural causes such as bridge openings restricted by debris or beavers. This section does not imply that areas outside the flood plain or land uses permitted within such areas will be free from flooding or flood damage.

Additionally, the granting of a permit or approval of a site, subdivision or land development in an identified flood plain area shall not constitute a representation guarantee or warranty of any kind by an official or employee of Chesterfield County of the practicality or safety of the proposed use, and shall create no liability upon Chesterfield County, its officials or employees. In the event the County allows a special use under the provisions of this manual, the applicant may be asked to execute an agreement holding Chesterfield County harmless from the effects caused by the construction or existence of the permitted use. Such an agreement will be recorded among the land records of Chesterfield County.

- X. Floodplain Management Ordinance** - The latest, most up-to-date version of the Chesterfield County floodplain management ordinance (Chapter 19, Article III, Division 3, “FLOODPLAIN DISTRICTS”) may be found in the County Code.

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EASEMENTS

I. GENERAL

- A. An easement is an acquired right, or interest, in a specific portion of land owned by another that entitles the holder of the easement to use the land for a certain stated purpose (not to be confused with right of way which, for the purposes of this manual, shall connote total ownership and related responsibilities, see Right of Way section).
 - 1. When described simply as "easement," the acquired right of the County presently includes use of the land to convey storm drainage, sanitary sewage, drinking water, cable TV lines, or as a related access. Use of easements is restricted by more specific descriptions. For example a "drainage" easement cannot be used for a sanitary sewer line - only for storm drainage and related access.
- B. The easement is a basic tool used by the County in overseeing and providing for orderly development. Unless otherwise stated, this chapter shall refer to easements dedicated in favor of the County of Chesterfield.
- C. The developer of land in Chesterfield County is required to provide to the appropriate party, all easements, both on- and off-site, public and private, determined to be necessary by governmental review.
 - 1. The County shall assume that an investigation by the developer of the need and feasibility of easement acquisition has been made prior to proceeding with the development.
 - 2. The County is not legally obligated to a developer in any way to assist in the acquisition of easements required by the Engineering Dept. There are certain cases, however, such as drainage easements for legally established drainage districts, County capital improvement projects, or other projects judged by the County to be in the public interest, that the Board of Supervisors may exercise the right of eminent domain and condemn for the easement.
 - 3. The legal dedication of all on-site easements occurs either when a subdivision plat, approved by the Planning Commission, is recorded in the Circuit Court Clerk's Office or by the recordation of a separate instrument document with plat in all other cases.
 - a. Easements shown on the subdivision plat which are not actually within the boundary limits of the land area being subdivided are not legally dedicated.
 - b. Separately recorded easements within the land area to be subdivided shall be shown on the recordation plat as "existing" with the deed book and page number given. Easements outside the subdivided area shall be shown on the plat to the extent possible, also with deed book and page number.
 - c. Where no land subdivision is to occur, as in the development of a commercial site, a copy of the recorded easement agreement and plat showing the deed book and page number is to be furnished to the Engineering Dept. prior to the release of a building permit.
 - 4. The legal dedication of all off-site easements which are required for the development of a project occurs only through a separate instrument recordation.
 - 5. Required separate instrument recordations are prerequisites to plan approval, recordation of related subdivision plats or release of building permits.
- D. The County shall have prior rights on all easements.

1. No easement (required for development) to any private utility company shall be deeded prior to the recordation of a subdivision plat or possible conflicting separate instrument.
 2. At the time of submission of the record plat, a check for clear County prior rights will be made in the County Record Room (Clerk's Office) by the Right of Way Section before the Environmental Engineer places his signature on the plat.
 - a. Quit claim deeds on all existing private easements which are found to be in conflict with the proposed County easements shall be recorded prior to the recordation of the related plat or release of a building permit.
- E. Permanent structures (buildings) or any conditions that would cause an unwarranted safety hazard, or undue hardship or inconvenience in access, use, maintenance repair construction etc., shall not be allowed to encroach into an easement.
1. In residential areas, the County will not approve or condone the placement of other encroachments such as fences, hedges, patios, clothes lines, gardens, driveways, etc. within County drainage easements, but will not require removal unless it negatively affects adjacent properties or County use of the easement is hindered.
 - a. In residential areas, maintenance of man-made facilities within County drainage easements conveying water from state rights of way is a service provided by the County of Chesterfield.
 - b. The County is only responsible for conditions related to the intended use or performance of the easement -- not for beautification, removal of dead trees, real estate value enhancement, etc.
 2. In non-residential areas, the encroachment into County drainage easements by paved road and parking surfaces, curb and gutter, medians, etc., is not legally or officially authorized. Through site plan review and approval, however, encroachment is conditionally permitted under terms whereby the restoration of any private improvements within the County drainage easement which have been altered or damaged by County use, maintenance, repair, construction, etc. of the legally authorized facilities in the County drainage easement, is the owner's responsibility.
 - a. In non-residential developments, the County approved facilities (man-made or natural) that the owner or developer is permitted to place in a County drainage easement to accommodate his development are his and his to maintain. Only where there is a breakdown affecting the overall storm water management function of the easement system (guaranteed legal conveyance of storm water runoff from upstream lands through the property) or damaging siltation to downstream areas and the owner(s) take no remedial action of their own would the County may opt to enter the easement to correct a condition detrimentally affecting off-site landowners. The County, in such cases, will only perform such work as to effect the remedial action. Replacement of facilities belonging to the property owner are the responsibility of the owner.
- F. The Environmental Engineer shall not approve the recordation of an easement unless it is in a condition complying with County standards or adequate engineering and bonding have been provided to insure that construction will ultimately achieve County standards, i.e. plan approval received for intended use.

Drainage Easements

- I. Drainage easements will be required, but not limited to the following:
 - A. Where water leaves the State right of way and the point of exit is not an adequate natural water course.
 1. The man-made improvements within the easement shall be designed at a minimum to contain 10 year storm discharges.
 2. Where protection of permanent building structures is in question, the base flood shall be analyzed through the improvements and the easement width established on the basis of containing the area of inundation or flood limits shall be indicated outside of the easement.
 3. The placement of riprap for energy dissipation or bank stabilization during initial development construction does not necessarily constitute a man-made improvement requiring easements.
 4. Where it is determined that conditions within the easement can remain in their existing natural state, easement widths shall contain the 100 year storm water surface spread. (determination to be made by Environmental Engineering)
 - B. To guarantee that upstream areas will have means to drain through the on-site property.
 1. Where on-site natural conditions need no alteration to accommodate the off-site upstream development, adequate permanent easements may be required.
 2. Where alteration of conditions is necessary to accommodate the off-site development, drainage improvements capable of accommodating the ultimate drainage from the upstream development shall be installed so as not to cause a disruption of living conditions at a later date.
 3. If circumstances are found by the Environmental Engineer to be such that the improvements should be postponed and made a part of the upstream developer's responsibility, a feasible design shall still be roughly established in order to determine permanent and construction easement widths and alignments. The area, however, shall be cleared and seeded.
 - C. In areas where no highway drainage is involved, the Environmental Engineer shall, at his discretion, require easements in order to place certain use limitations in areas critical to the provision of adequate drainage for lots (see "Swales" in "Open Channel" chapter).
 - D. In any location where there is a need for a guarantee of legal and permanent passage of storm water runoff.
 1. This will be applicable when their prime concern that the unrestricted use of a certain portion of property could detrimentally affect adjacent landowners from a flooding standpoint; or
 2. To preclude the otherwise legal filling in or blockage of an adequate natural swale being used to convey storm water to a watercourse in the rear of lots or parcels fronting on a State road; or
 3. Strict compliance with County standards may be in conflict with or undesirable in light of adjacent circumstances on the land through which the easement passes (e.g. golf courses, recorded open spaces, flood plain/wetlands).
 - a. The drainage course within this easement may actually be an adequate natural watercourse.
 - b. The County has no maintenance responsibilities in these areas to the landowner through whose property the easement passes, but does have the right to enter the

property in order to remediate any conditions which may detrimentally affect upstream or downstream landowners.

c. There is a special easement agreement which covers this scenario.

4. A flood plain designation in accordance with the County Flood Plain Management Ordinance may be a suitable alternative.

II. Drainage Easement Locations

- A. Natural topographic features shall be utilized, as much as is practical, to establish both the alignment of drainage easements and the lot property lines which shall coincide with the easement center line.
- B. The location of drainage easements must coincide with and contain the storm drainage as it is physically located in the field.
- C. In subdivisions, unless storm sewered or otherwise approved, drainage easements should not be aligned such that they separate more than 20% of the total lot area from the rest of the lot on the other side of the easement.
- D. Unless containing a storm sewer, paved ditch, or "daylighting" channelization, improvements in drainage easements shall terminate upon reaching the limits of a major, wide, flat and swampy 100 year flood plains.

Easement Width

The minimum width for drainage easements shall be sixteen (16) feet.

I. Storm Sewers

- A. Refer to the below matrix to determine the minimum easement width for a storm sewer:

MINIMUM EASEMENT WIDTH MATRIX										
DIAMETER OF PIPE IN FEET (D)										
	1.25	1.50	1.75	2.00	2.25	3.00	3.50	4.00	4.50	5.00
1	16	16	16	16	16	16	16	16	16	16
2	16	16	16	16	16	16	16	16	16	16
3	16	16	16	16	16	16	16	16	16	16
4	16	16	16	16	16	16	16	16	16	16
5	16	16	16	16	16	16	16	16	16	16
6	16	16	16	16	16	16	16	16	16	16
7	20	20	20	16	16	16	16	16	16	16
8	20	20	20	20	20	20	20	16	16	16
9	20	20	20	20	20	20	20	20	20	20
10	25	25	25	25	20	20	20	20	20	20
11	25	25	25	25	25	25	25	25	25	20
12	30	30	30	25	25	25	25	25	25	25
13	30	30	30	30	30	30	30	25	25	25
14	30	30	30	30	30	30	30	30	30	30
15	35	35	35	35	35	30	30	30	30	30

- B. For pipe diameters greater than five (5) feet and/or a maximum elevation difference between the invert of a pipe and the ground greater than fifteen (15) feet, the following equation shall be applied, with the result rounded up to the next highest five (5) feet.

Easement width = $(D + 3) + 2*(H - D)$, where

D = pipe diameter in feet and

H = maximum elevation difference between invert of pipe and existing ground, in feet

- C. An engineering assessment of the physical conditions (existing or proposed) within the width of the easement shall then be performed to establish if a 100-year surcharge is contained within the width of the easement. If this is the case, the construction plans shall indicate that the 100-year storm is contained within the proposed easement width. If this is not the case, the easement width may be increased to do so, or the limits of the additional area inundated by the 100-year storm shall be shown on the plan and plat.

II. Open Channels

- A. The width of the easement shall at a minimum be sixteen (16) feet or provide containment of the 10-year storm improvements, whichever is greater.
- B. The easement width for an open ditch shall always be greater than the "top of ditch to top of ditch" dimension (T), as shown on the plans, unless side slopes are 4:1 or flatter.
- C. An analysis of the total ditch cut cross section will be made to determine containment of the 100-year storm. If the 100 year storm is contained, the 10 year easement standards will suffice. If the ditch does not contain the 100 year storm, limits of inundation area shall be outlined by a 100 year flood plain with the top of the ditch establishing the maximum width of drainage easement.

III. Future Construction

- A. Where engineering can establish feasibility, easements to allow a future upstream developing area to construct improvements tying into the drainage facilities being provided by the on-site developer, shall be of a width necessary to accommodate the construction of a storm sewer.
- B. When open channels are the only feasible means of conveying future storm water runoff, the easement width must be the full extent of the necessary ditch cut, plus construction easement.
- C. Adequate accompanying construction easements will be recorded adjacent to the permanent easements at a width and location to be determined based on a case by case determination.

Construction Plan Requirements For Easements

- I. All existing easements (including the name of the specific holder) such as Chesterfield County easements, Virginia Power and C&P easements, and petroleum or gas easements shall be shown on the subdivision or site construction plans as well as the recordation plat.
- II. All proposed easements, excluding rear yard easements, shall be shown on the subdivision or site construction plans.
- III. Any field taken cross sections that may be necessary to prove or establish compliance with minimum design criteria shall be included in the plans.
- IV. The design cross-section and lining within the easement shall be indicated.

- V. Plans shall include profiles of existing and proposed center lines and where adequate capacity is of question, profiles to the left and right of center line at the easement limit. They shall be stationed on both the profile sheet and plan sheet.
- VI. Profiles of storm sewers and open ditches on commercial site plans are required whether contained in easements or not.
- VII. Profiles of existing channels shall include "top of bank" at its distance left and right of center line.
- VIII. Included on the drainage profiles shall be profiles or cross-sections, as applicable, of any other utilities that share or cross the easement alignment.

Off-Site Drainage Easements

A definite increase in the amount and rate of storm water runoff is usually associated with land development. This increase can cause an imbalance in the natural waterways established by nature which must be given due consideration to prevent downstream flooding as well as damage. Also, existing man-made or improved facilities may be incapable of adequately handling the increased runoff due to (1) original improper design or construction, (2) upstream development occurring at a higher density than originally assumed.

In the interest of the health, safety and welfare of all and in consideration of a prime responsibility of this office - the protection of existing development to the extent possible from the negative impact of new development - the County reserves the right to require the developer to make appropriate provisions in any off-site area, including but not limited to existing County easements, where the development of the property may have a negative impact. Such arrangements shall be worked out prior to any approval of construction plans, plat recordation, building permit or issuance of a land disturbance permit.

Whether an off-site easement is for the improvement of an inadequate condition or a continuation of on-site facilities extended into an off-site area in order to reach a drainable outfall, no plat will be recorded or building permit released or land disturbance permit issued on land which would drain in the direction of the off-site easement until the easement has been duly recorded and bonding for the improvements within said easement has been approved by the County Attorney.

The Environmental Engineer has the discretion to require all developments, whether subdivision or commercial, which are subject to County and Highway review, to have drainage conveyed via easement to an adequate natural watercourse as defined in the most current edition of the Virginia Erosion and Sediment Control Handbook, as a minimum. Easements to a greater extent may be necessary where conditions are warranted. The final determination is to be made by the Environmental Engineer.

VDOT Easements

- I. The arrangement between the Virginia Department of Transportation and Chesterfield County is that in order for them (VDOT) to take over maintenance of road rights of way, the County must see that: (1) drainage easements in favor of the County are dedicated to an adequate natural watercourse and (2) provide maintenance of same.
- II. In locations where an existing state maintained road will be draining into a newly subdivided area, the drainage easement to guarantee continued maintenance and conveyance of water coming from the existing state maintained road may be a Virginia Department of Transportation easement. It shall be recorded as a VDOT easement through subdivision plat recordation or prior to building permit issuance (site).
 - A. Prescriptive outfalls from existing highway right of way draining into the property to be subdivided shall be legally dedicated as easements to the Commonwealth of Virginia if the contributing drainage area of the right of way is greater than the upstream non-right of way acreage. The deed book and page number shall be shown on the subdivision plat.

- B. Prescriptive highway outfalls, which are also serving to allow significant upstream drainage to pass through the right of way, shall become County drainage easements through the recordation of the subdivision plat.
- C. Existing recorded VDOT easements will be extended as such until reaching the County dedicated right of way or an adequate natural watercourse.
- D. Drainage easements necessitated by any new VDOT contracted road projects shall be dedicated to the Commonwealth of Virginia except in the cases of recreational and industrial access projects.
- E. Drainage easements enclosing storm sewers whose points of access are only in right of way shall be VDOT easements.

Any drainage conveyance system, whether natural or man-made, which runs immediately parallel to road right of way or serves as an alternative to standard roadway drainage facilities, (i.e., roadside ditches or curb and gutter), shall be encompassed within Highway right of way. Where additional right of way is not feasible, these areas shall also be Highway Department drainage easements handled by the same procedures as stated previously.

Slope Easements

I. Areas Under Development

- A. Fill Slope Easements:
 - 1. Fill slope easements are required in cases where road construction and/or a related drainage system in a fill section extend beyond the limits of the proposed right of way width and where it is not feasible to widen the right of way to encompass the total section.
 - 2. The appropriate width VDOT slope easements adjoining the right of way shall be recorded on the applicable plat.
 - 3. When storm drainage facilities pass through or are contiguous with the fill slope, the easement shall be termed as a VDOT slope and drainage easement.
 - 4. Additional right of way is the preferable alternative to a fill slope easement.
- B. Cut Slope Easements:
 - 1. As long as the slope on roadway cut slopes is the standard 3:1 or flatter, additional right of way or slope easements are not required even though the cut section extends beyond proposed right of way width. The cut slopes will be considered an existing condition on the lot bought by the property owner and will be his responsibility for maintenance.
 - 2. Where certain constraints do not allow the construction of 3:1 cut slopes, a VDOT cut slope easement will be provided adjacent to the right of way when the permitted slope becomes steeper than 2:1.

II. Slope Easements for Future Development Areas

- A. Where a developer is required to record certain rights-of-way which will not have any construction take place (in most cases stub roads), an existing ground and proposed road profile extending on the proposed center line of right of way alignment 300' beyond the property line into the adjacent property shall be provided in the plans. A feasible road approved by the VDOT shall be designed, and any slope easements needed, whether fill slope or cut slope, based on the proposed future road design, shall be recorded adjacent to the right of way.

- B. A minimum 10' slope easement contiguous with each side shall be dedicated with all right-of-way stubs.

VDOT Sight Distance Easements

- I. VDOT sight distance easements are required where minimum intersection sight distance criteria is not met due to a vision blockage caused by existing vegetation, fence, sign, etc. rather than by highway geometrics. This easement permits the removal of those conditions causing the vision blockage and precludes the return of any future vision blockages.
- II. When the sight distance easement is within the limits of the subdivision, it shall be indicated as a VDOT sight distance easement and conveyed to the Highway Department's maintenance system by resolution of the Board along with the roads.
- III. When the sight distance easement is off-site, the acquisition of the easement shall be a prerequisite to the recordation of the subdivision.

Easement Transfer to the VDOT

- I. At such time as the roads and subdivisions have been satisfactorily completed, VDOT easements are turned over to the Virginia Department of Transportation along with recorded rights of way by official resolution from the Chesterfield County Board of Supervisors.

Backwater Easements

- I. When the proposed construction of a road fill crosses a watercourse or when the filling of the floodway will generate a backwater condition which exceeds the limits of the original flood plain, consideration as to the ownership of that additionally inundated land must be given.
 - A. If it is land owned by the developer and is a part of the developing project, the backwater will establish the new limits of the 100 year flood plain with recordation of that backwater area on the subdivision plat. Development in consideration of the new 100 year backwater shall then take place. Storage volume is not a consideration for becoming a backwater area.
 - B. If the design of a culvert has taken into account the storage volume within the backwater, it shall be a storm water detention easement which restricts any activities that would reduce the existing available upstream volume.
 - C. If the land affected by the backwater is owned by others, the storm drainage design based on ultimate upstream development, will be revised to reduce the backwater area to within a flood plain cross-section at the off-site property line established without the effect of the proposed embankment or permission in the form of a backwater easement from the landowner shall be obtained. Recordation of this easement shall connote no maintenance on the part of Chesterfield County. It will, however, serve as official permission and permanent acknowledgment of a facility which theoretically reduces the area subject to development on the affected land and places a restriction on any future filling within the backwater area. This back- water easement will be shown on all subdivision plans and recorded plats.

Rear Yard Easements

- I. A rear yard easement in accordance with the most current subdivision ordinance shall be dedicated along the rear of all recorded subdivided lots. Under normal circumstances, it shall extend equally on each side of the common property lines between the lots.
 - A. When the rear of one lot coincides with the side of another, it shall be dedicated on each property.

- B. Cable television is considered a County provided service and is entitled to use rear yard easements.
- C. When field conditions along rear property lines are such that they would preclude reasonable use of the rear yard easement or where reasonable use of the rear yard easement would be detrimental to conditions along the property line, the alignment of the rear yard easement shall be suitably altered.
- D. A rear yard easement shall not be recorded over an existing natural watercourse which establishes the common back property line of two lots. Instead, easements shall be recorded at a suitable distance to each side of the watercourse.
- E. The Environmental Engineer shall have the right to alter these requirements when he deems it necessary to the possible extent but not limited to changes in location and altered width.

Ingress and Egress Easements (Private)

- I. These easements will be utilized primarily when the physical conditions (e.g. severe topography or drainage) between the lot frontage and the homesite are not conducive to the construction of a driveway. Passage through a portion of an adjacent lot becomes more desirable.
 - A. The alignment of this passage shall be contained by a minimum 20' Ingress/Egress Easement on the subservient lot with an appropriate reference to a note on the subdivision plat which states, "The 20' ingress/egress easement located on the servient lot is for the private and exclusive use of the dominant lot which has full and permanent maintenance and upkeep responsibilities. A minimum 10'4" wide gravel driveway facility shall be maintained in good condition at all times by the owner of the lot (the dominant lot)."
 - B. No building permit shall be issued nor certificate of occupancy released until inspection by Engineering Department personnel has confirmed conditions within the easement are in good condition and in accordance with the above criteria.

Greenway Easements

- I. Greenway easements are designated areas within the subdivision with a recognized environmental benefit and sensitivity to man-caused disturbances. Aside from being areas of natural beauty, their designation will be mainly a storm water management consideration as opposed to open spaces, which do not necessarily perform a storm drainage function. Where applicable, greenway easements can be utilized as an alternative to on-site drainage easements or where a restriction from vegetative disturbance is needed in order to maintain an existing natural drainage feature which will remain in harmony with the surrounding subdivision development. The concept of a greenway easement in Chesterfield County is based on the fact that if existing natural conditions are well stabilized, densely vegetated and do not contain highly erodible soils, and they can withstand the impact of some additional water due to development with negligible deterioration and have significant environmental and economic benefits.
- II. The same basic engineering determinations which are needed for improvements within drainage easements are needed to determine applicability of conditions for a greenway easement with some of the following restrictions:
 - A. The zoning of the property must meet, as a minimum, R-25.
 - B. The area must be a large topographic swale whose side slopes and/or unsuitable soils are much less desirous than adjacent plateau areas for homes and drain fields.

- C. The width of the greenway easement will be no less than 50 feet. The basis for establishing a greater width will be on the maximum probable area of storm water inundation plus as much additional buffer area as will not unduly restrict the reasonable use of the property through which the greenway passes.
- D. Should some undesirable conditions exist within the portion of the greenway easement which is inundated by normal storms, the greater width buffer will act as a shield between the decreased desirability of the area and the home constructed on the lot.
- E. A greenway easement will not be an area into which a storm sewer picking up greater acreage than which originally drained through the swale can discharge, rather it will be an area in which a road culvert is used to maintain an existing drainage pattern which was present prior to the crossing of the swale by a road fill. Road grades and the roadside ditches will be designed to only bring areas which drain naturally down the swale. There will be no cutting through knolls.
- F. The low area of water flow centralization will be flat and wide with no existing naturally eroded low flow earth channels. Once an existing eroded, earth lined, low flow channel is in evidence, there is an indication that the erosion process will continue with the additional water being discharged into the swale, therefore, a non-qualifying condition. The drainage flow through a greenway easement shall be non-continuous, only occurring during periods of storms.
- G. As a rule, a 15" culvert will be maximum size pipe allowed to discharge in the area for a greenway easement designation. The disturbance restrictions will apply to activities to include, but not necessarily limited to, water line construction, sanitary sewer line construction, telephone utility lines, electric utility lines, cable TV lines, any and all underground pipelines, fences, off road vehicles, etc.
- H. The Environmental Engineer must give alignment approval for any easements needed for the above uses, prior to their actual recordation, to provide some protection of the natural conditions within the greenway easement.
- I. The Environmental Engineer or his agent shall maintain full rights to enter the greenway easement and will be the source by which written permission must be granted prior to any man-caused disturbance in a greenway easement. He will inspect greenway easements prior to any release of building permits or certificates of occupancy on affected lots and may require improvements as needed.
- J. Ultimately, it will be the developer's responsibility to respect the integrity of the greenway easement prior to State acceptance by insuring that he does not allow such disturbances as siltation or telephone and electric services to be placed in the area. Responsibility for the integrity of the greenway easement passes to the individual landowner through whose property the greenway easement passes after State acceptance. Any deterioration of conditions requiring corrections in a greenway easement caused by a failure to preclude man-caused disturbance will be the responsibility of the developer (or individual owner), depending on the timing. The developer, or individual owners, as the case might be, shall implement, and be responsible for, corrective action.
- K. The landowner's restrictions in a greenway easement shall be the same as those essentially on a standard easement, except as follows:
 - 1. As a contingency, road and drainage plans may call for intermittent hand-placed stone check dams to be placed across the greenway easement, if erosion or sedimentation from denuded roadway areas begins to occur. This requirement will be at the discretion of the construction inspector or the review engineer.
 - 2. Erosion control protection for these areas will normally call for large, deep pits in combination with silt fence and stone filter, to be dug immediately downstream of the man-

made discharge point to provide a place for silt to settle out before water continues downstream.

- a. On a permanent basis, the volume of the pit (specified in the plan in terms of length, width and depth) will be lined with filter fabric and filled with high void uniform gradation of 12" stone to an elevation matching existing surrounding ground. This facility will act as a stilling basin which will also aid in groundwater recharge and be an effective form of energy dissipation.
- L. In locations where the Utilities Department has requested an easement in an area encompassed by a greenway easement for an projected future sewer, the alignment of that easement shall be outside the portion of the greenway easement inundated by the base flood.
- M. When greenway easements are recorded on the subdivision plat, the plat shall read: "The greenway easement shown hereon shall be for the guarantee of storm water conveyance through lots on which it is located. It is to be left in its natural state and not disturbed, under any circumstances, without permission from the Chesterfield County Environmental Engineering Department." Each lot so affected shall have some type of delineation that refers to the note.

Temporary Easements

I. On-site temporary turnaround easements:

- A. Shall have a minimum 50' radius.
- B. Shall have limits corresponding to the terminus of right of way dedication. Road construction is required through the full length of the dedicated right of way.
- C. Shall extend beyond the permanent right of way into the lots a distance necessary to provide a VDOT approved pavement radius (35' min. in subdivisions) cul-de-sac and adequate roadside ditches.
- D. Once a valid attempt to acquire the necessary off-site easements has been documented as unsuccessful and at the Environmental Engineer's discretion, the turnaround easement may be located at a road drainage break where possible to avoid off-site drainage improvements and/or easements while still providing a minimum frontage as required by the subdivision ordinance measured around the right of way perimeter for any lot on the cul-de- sac.
- E. Where possible, the turnaround and temporary easements should be aligned such that only one lot is affected.
- F. The future developer will be totally responsible for any necessary design or construction for (1) removal of the cul-de-sac, (2) relocation of entrance culverts, (3) extension of curb and gutter to the property line (even if his own subdivision has roadside ditches), (4) any additional drainage improvements, (5) road and drainage construction in existing right of way due to cul-de-sac being constructed at drainage break rather than to the property line, or (6) any utilities adjustment
 - 1. Drainage breaks shall be considered in determining the necessity for extending curb and gutter.
 - 2. Curb and gutter shall not terminate after partially extending across a lot frontage. Curb and gutter must terminate at a property line.
- G. When action by the Board of Supervisors and/or the Planning Commission has changed the status of a temporary turnaround to a permanent cul-de-sac in connection with a particular project, the developer of concerned shall be fully responsible for all necessary adjustments to include, but not

limited to, road name changes, construction of the permanent road and drainage improvements, conversion from easement to right-of-way, etc., only if such developer has lot access.

- H. The temporary turnaround easement ceases to exist once the extended road receives state acceptance. This statement shall appear on all applicable subdivision plats.
- I. Where it is not possible to construct a temporary cul-de-sac on a drainage break, an easement to an adequate natural watercourse (meeting State GC-7 criteria) is required regardless of the amount of runoff generated.

II. Off-site Turnaround Easements

- A. Where land adjacent to the proposed terminus of the road is owned by the developer or a cooperative land owner, the developer is encouraged to construct the temporary turnaround outside of the limits of the proposed subdivision recordation in order that the final permanent road improvements can be totally constructed without future disruption to the road.
- B. The Right of Way Section has the appropriate documentation to legally record off-site temporary turnaround easements. This being an off-site easement, recordation of such with deed book and page number is required prior to the recordation of the subdivision plat.

III. Temporary Drainage Easements

- A. Off-site drainage easements to adequate natural watercourses are sometimes required as prerequisites to future development.
- B. Drainage easements will be made temporary by special provisions which will describe the circumstances under which the easement would be terminated.
- C. The special provisions in the temporary Drainage Easement Agreement shall provide for a termination of that easement if, at the time of development of the future section, constructed improvements provide an alternate routing and easement for drainage. Otherwise, if the easement is included on the subdivision plat of the future section with its deed book and page number indicated, or if a new easement is recorded over top of it, it shall become a permanent drainage easement.
- D. Temporary off-site drainage easements are only applicable when the land through which the easement passes is undeveloped.
- E. The alignment of the easement at this point would follow the route established by the natural topography. Stabilization improvements may be necessary.
- F. Execution of this off-site separate easement is prerequisite to plat recordation or release of building permit.

IV. Construction Easements

- A. Construction easements are areas of specified width, contiguous and adjacent to a permanent easement, which allow for use by the contractor of this area for the period of time the permanent facilities are being constructed within the limits of the permanent easement.
- B. Construction easements are called for primarily adjacent to utility easements which are being recorded on the subdivision plat in anticipation of future trunks or collectors being extended upstream through the property.

- C. The location and width of these easements shall be as specified by the Department of Utilities.
- D. As a rule, construction easements adjacent to drainage easements will not be required on subdivision plats, as all drainage construction necessary within the subdivision takes place at the time of initial development.
 - 1. Only in those locations where a variance by the Environmental Engineer allows on-site drainage improvements necessary to accommodate the drainage of upstream properties to be constructed at a later date, will construction easements adjacent to on-site drainage easements be required.
- E. The construction easement will generally be 10' in width to each side of the permanent easement.
- F. In the acquisition of off-site drainage easements where drainage improvements will take place, the County must be assured that the width of the permanent easement is wide enough to accommodate related construction of the permanent facilities or the acquisition of a construction easement adjacent to the permanent easement has been acquired prior to County approval.

Alley Easements

- I. Alley easements are no longer required in Chesterfield County but do exist in older platted areas. Alley easements can be used to convey storm drainage if the subdivision certificate so states.

Streetlight Easements

- I. See section on Streetlight Policy.
- II. Streetlight easements need not be shown on the record plat, but if not shown, they must be specifically cited in the subdivision certificate in such language as to meet the requirements of the streetlight policy

Acceptable Conditions in Drainage Easements

- I. Constructed drainage facilities must be built and perform in accordance with County standards as per design approved in construction plans.
- II. Where drainage easement facilities have been buried, the area within the easement must be refilled in such a manner as to not interrupt the natural passage of surface water across the easement or create pockets of standing water.
- III. All drainage easements shall be adequately stabilized by a permanent stand of vegetation.
- IV. All excavated material, unless utilized to provide smooth transition into adjacent ground shall be removed from the drainage easement area or from the areas adjacent to it.
- V. Final conditions of drainage easements will be free of trash, dead trees, temporary erosion control measures, etc.
- VI. All underground utility lines and ditches shall be properly filled in and stabilized with no sinking areas to evidence where the line was installed.

PROCEDURE FOR THE RECORDATION OF SEPARATE INSTRUMENTS

- I. For all developments where drainage does not flow either to a natural watercourse or to an existing easement containing adequate facilities, the Developer must make all possible efforts to secure an easement to an adequate natural water course by negotiation with the owner of the land where the easement will be located.
- II. The Developer shall have submitted to the Right-of-Way Section of the Department of Utilities four copies of the proposed plat.
 - A. The information on the plat shall be in accordance with the easement checklist included herein.
 - B. All plats will be submitted to the Right-of-Way Section with an attached transmittal letter which shall explain generally the circumstances precipitating the need for the easement recordation and the name, address and telephone number of the person to whom the Right-of-Way Department will mail the prepared documents.
 1. The Right of Way Section will process plats submitted directly to them for drainage and slope easements. The plats along with the letter of explanation will be routed through, and approved by, Environmental Engineering before they will be attached to the appropriate Agreement Document by the Right of Way Section.
 2. If review and approval are required for related engineering, it shall have been substantially completed to the point of assuring that the plat will be valid before the Engineering Dept. will give the Right-of-Way Section the approval to attach the agreement document to the plat.
 - C. It is recommended that a preliminary plat be submitted to the Environmental Engineer for review prior to the submittal of the four shaded final plats.
 - D. After the review by the Engineering Department has found the plat to be valid and accurate, the plat will be sent back to the Right of Way Section with instructions to either attach the documentation and to record when signed easements are returned, or to attach the documentation only and send to the specified person, but no recordation until further approval by Environmental Engineering.
 - E. Once the appropriate signatures have been obtained, the easement plat and document should be returned to the Right of Way Section with the current recordation fee (established by the Clerk of the Circuit Court).
 1. The name, address and telephone number of the Grantor shall also be provided to the Right of Way Section when the signed agreement is returned.
 2. After the Right-of-Way Section receives the signed agreement and fee, it is sent, via the Engineering Department, to the County Attorney and County Administrator for their approval. The easement agreement is then sent back to the Right of Way Section for its handling of the actual recordation in the Clerk's Office.
 3. The easement agreement is placed on record, a Deed Book and page number is assigned and placed on the agreement, and the original agreement returned to the Right of Way Section. A copy of the recorded agreement is forwarded to the Environmental Engineering Department from Right of Way.
 - F. VDOT approval, where applicable, as well as County approval, of all off-site easements including slope or construction easements is necessary prior to the actual recordation. The County will, however, process the paper work prior to the actual approvals.

- G. Prior to the implementation of improvements in off-site easements the owners of the property, through or between which the easement passes, should be notified by the developer.

Easement Vacations and Quit-Claims

- I. Existing easements whose use or potential for use has been eliminated by an alternate development approach will be vacated prior to or along with a subdivision plat recordation or building permit release.

- A. Vacation of easements recorded by subdivision plat.

1. There are two alternatives in easement vacation:
 - a. Through a vacation procedure established by State statute and handled for the County by the Right-of-Way Section. Copies of the current policy are available in the Right-of-Way Section.
 - b. Vacation can occur through a plat amendment procedure as a part of the Subdivision Ordinance handled through the Planning Department.
 1. The amended plat shall omit the easement to be vacated. The title of the plat would be, for example "Amendment of Lots 2 and 3, Block B, Sec.1, of XYZ Subdivision and the vacation of drainage easement between Lots 1 and 2."
 2. All fees required by the Planning Department shall be paid by the individual making the amended plat request.

- B. Vacation of easements recorded by separate instrument.

1. This vacation procedure shall be accomplished by the recordation of a quit-claim deed if approved by the County Board of Supervisors.
 - a. This process is also handled by the Right-of- Way Section who will seek approvals from affected departments prior to pursuing the matter (e.g., a separate instrument recorded as a drainage easement shall require only the approval of the Environmental Engineer. A separate instrument recorded as an "Easement" shall need the approval of all Departments.)
 - b. The original plat accompanying the easement agreement can be used and attached to the quit-claim deed as well.
 - c. There is no public hearing required for the vacation of an easement recorded by a separate instrument.
 - d. The fee for the vacation of an easement through the quit-claim deed procedure shall be paid by the individual requesting the vacation to the Right of Way Section.

- C. VDOT Quit-claims.

1. In the review of the construction plans, those areas of proposed right of way recordation which will ultimately contain State-maintained roads that conflict with any existing easements, shall require that a quit-claim of rights by the holder of the existing easement be made in favor of the Virginia Department of Highways and Transportation.
 - a. This involves the developer, the Highway Department, the holder of the easement, and the County of Chesterfield. Prior to recordation of the subdivision, the County must be officially notified by the easement holder that the construction proposals as portrayed in the plans under review by the County

and VDOT are, along with any provisions specified by the easement holder, compatible with the existing easement facilities and that with their receipt of an official letter from VDOT that the roads are ready for state acceptance, will initiate quit claim procedures. Prior to Board of Supervisors resolution for state acceptance, a copy of the quit claim deed will be provided to the County.

D. Quit-claims for County easements.

1. Non-county easements existing prior to the inception of the development (e.g. Virginia Power high tension line R/W easement) may not be subject to quit-claim requirements.
 - a. If in the opinion of the Environmental Engineer the potential liability for the County is minimal, the procedure will be to present a design in the construction plan which, in the best judgment of all, will not create a conflict between the original use and the new proposed use in the County easement.
 - b. Approval from the particular institution (e.g., Commonwealth Gas) over which the County easement will be recorded is also required. The proposed design for construction must be submitted to the holder of the existing easement and a letter from the institution approving the proposed design within the easement shall be received by Environmental Engineering prior to construction plan approval.
2. Quit-claims reversing prior rights are required in those situations where easements other than County easements have been necessitated exclusively by the subject development (e.g., underground Virginia Power and C & P service cables).
 - a. It shall be the developer's responsibility to see that this type of easement is not recorded prior to the subdivision plat and to see that the location of the proposed private utility easements will not be a detriment to the uses in the easement dedicated to the County.
 1. It is suggested that the developer have his engineer and the Environmental Engineering Department review the location of any proposed easements that will be dedicated separately from the subdivision plat prior to the actual recordation of such easement.
 2. Until such time the roads go into the State system, it shall be the developer's responsibility to remediate any adverse conditions caused by conflicting easement uses of the same portion of land.

E. All quit-claims in favor of County easements will be required prior to the recordation of the subdivision plat or prior to the release of building permits when no recordations are involved.

Easement Agreement Checklist

1. Specify type and/or specific use of easement.
2. Where the owners are married, both must sign the agreement.
3. Owners' and trustees' signatures must be notarized.
4. Note holders signatures must appear but need not be notarized.
5. Owner's names on the agreement must coincide with owner's name on the plat.
6. The name of the firm which prepared the plat shall be the same on both the agreement and plat.
7. Where multiple plats are involved, each should be designated numerically and the agreement should include language such as "Plats 1 of 3 and 3 of 3 each dated ..."
8. Every revision date of the plat must be noted on the agreement.
9. Any changes or deletions on the agreement must be accompanied by initials of the owner/s.
10. When an additional easement is required within a previously recorded subdivision, a separate plat is required. It shall include the plat book and page number where the original subdivision plat is recorded.

Easement Plat Checklist

1. Specify type of easement.
2. State grid north arrow.
3. Show scale 1"-50' or 1"-100'.
4. Plat size shall be determined by the Clerk of the Circuit Court.
5. Date drawn and by whom, also checked by whom.
6. Distances and bearings of easement and parcel or lot through which it passes.
7. Width of easement with dimensions to each side of center line.
8. Easements shall be tied down to an existing reference point, e.g. PI of the nearest existing intersection.
9. Right of way width, name, and state route number of adjacent road.
10. Curve data of easement or right of way alignment if not on a tangent.
11. Where easements do not run along a property line, distances to property corners shall be given from the point where the easement may intersect a property line.
12. If in a subdivision, show lot, block, section and name of subdivision.
13. Property owners' names, deed book and page number showing where the owners' deeds were recorded.
14. All adjacent landowners.
15. If in a subdivision, tie-down will also be accomplished by state grid coordinate system.
16. Off-site easements exiting proposed subdivisions may be tied down by its distances and bearings as long as the exit point, any angle turns, and the terminus of the off-site easement are tied to state grid coordinate system.
17. Title "Plat showing 30' drainage easement across the property of ... " to include owners, legal description and/or tax map no., district, county and state.
18. Include any related construction project name and/or number.
19. Show any existing easements in relation to the proposed easement.
20. The signed seal of the certified land surveyor.

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EROSION AND SEDIMENT CONTROL

I. General

- A. The Chesterfield County Erosion and Sediment Control Ordinance, Chapter 8 of the County Code, is put into practical application under the framework as provided by the Virginia Erosion and Sediment Control Handbook, 2d Edition, 1980. This publication, which may be purchased from the Division of Soil and Water Conservation of the Department of Conservation and Historic Resources, 203 Governor Street, Suite 206, Richmond, Virginia 23219-2094, (804) 786-2064, serves as the official erosion and sediment control handbook for Chesterfield County.
- B. The term "erosion and sediment control" not only refers to those measures that are of a temporary nature implemented during the time of construction to minimize the migration of silt from denuded portions of a construction project onto downstream land (sediment control), but also refers to the provision of adequate measures of stabilization required for acceptable permanent conditions (erosion control).
- C. "Erosion control" deals with the initial dislodging of soil particles and includes more permanent practices such as seeding denuded areas or paving channels which have erosive flow velocities. "Sediment control" addresses the temporary period of necessary land disturbance associated with development and seeks to provide temporary measures which will properly manage the movement and deposition of the dislodged soil particles (e.g., staked straw bales, filter fabric silt fences, silt basins).
- D. Pending publication of a revised State regulations format, the State General Criteria (GC-1 through GC-14) set forth standards which apply to all land disturbance projects regardless of whether reference is made to them (general criteria) in the plans. Compliance with all applicable general criteria is necessary for the issuance and continued validity of the land disturbance permit.
- E. Nothing in the General Criteria shall limit the right of the Environmental Engineer to impose additional or more stringent standards for controlling erosion and sedimentation, or to waive or modify any of the General Criteria which are deemed inappropriate or too restrictive for site conditions during the plan approval process.
- F. The GC-7 Criteria is designed only to prevent severe channel erosion directly downstream from development sites. Comprehensive watershed planning needed to control the problems of flooding and pollution will be a County case-by-case option.
- G. "Land Disturbance" shall be considered to have occurred once the root mat of the topsoil is penetrated. An operation using chain saws, etc. to cut down trees at the trunk without disturbance of the stub is not an activity covered by the Erosion and Sediment Control Ordinance. However, it may become an unlawful activity if vegetative disturbance restrictions are placed on the project at time of rezoning or Planning Commission review.
 - 1. If, in the review of proposed zoning or Planning Commission cases, the Environmental Engineer determines that the clearing of land is detrimental from a storm water management standpoint as well as from an erosion and sediment control standpoint, he may recommend to the appropriate Board that no vegetative disturbance be permitted until such time as certain conditions are adhered to. If the projects are approved subject to such conditions by the Board of Supervisors or Planning Commission, the achievement of such conditions become prerequisites to the issuance of the Land Disturbance Permit. The vegetative disturbance shall also become a violation of the Zoning and/or Subdivision Ordinances, as applicable.

2. The Erosion and Sediment Control Plan for a project shall not qualify for review and approval by the Environmental Engineering Department until the project has received all necessary zoning and Planning Commission approvals. Copies of the final approval, zoning and/or Planning Commission minutes must be submitted with the site plan and/or subdivision construction plans.
- H. Erosion and sediment control is, therefore, an integral part of any construction plan for development. Construction plans submitted without erosion and sediment control designs included shall be considered incomplete and shall not be reviewed by the Environmental Engineering Department unless and/or until design for erosion and sediment control as per the Virginia Erosion and Sediment Control Handbook is made a part of the plans.
- I. The contents of this chapter whether mentioned specifically or not shall be a part of the erosion and sediment control program of all land disturbance projects.

II. Land Disturbance Permit

- A. The Environmental Engineering Department cannot issue a land disturbance permit until all of the following conditions are met (see Permit Procedures):
 1. The engineering plan meets the conservation standards criteria and specifications as promulgated by the Chesterfield County Environmental Engineer or as contained in the Virginia Erosion and Sediment Control Handbook. Erosion and Sediment Control plans shall, at a minimum, include the following information:
 - a. Existing and proposed topographical contours, road center line and offset profiles.
 - b. The limits of clearing. This shall include the area disturbed by road construction through the extent of fill or cut slope, tie-in to existing ground.
 - c. Delineation of all drainage break points (on- and off-site).
 - d. The location and drainage area of all proposed road culverts and the acreage of these disturbed areas within.
 - e. The location, drainage area acreage, and disturbed area acreage of all proposed silt control measures (using worst case for design purpose).
 - f. Restricted or designated access points with stone entrance pads per Std. & Spec. 1.01.
 - g. Recommended stockpile location and applicable erosion and sediment control provisions.
 - h. Satisfaction of all State minimum general criteria.
 - i. All applicable calculations.
 - j. Any standard or specific notes, as requested by the plan reviewer.
 - k. Standard detail sheet.
 - l. The location of all proposed sanitary sewer and water utility lines.
 - m. The location of all buffers and widths.
 2. The permit application (see Sample Permit) has been signed by the Owner and notarized only after the contractor has been designated and provided a copy of the approved plan stamped in red "Erosion Control Approved."
 - a. This action legally establishes the ultimately responsible party for correction of any erosion and sediment control problems prior to occupancy and/or state road acceptance, and/or bond release.
 3. The program administration fee has been paid to the Engineering Department, made payable to the Treasurer of Chesterfield County.

4. An itemized unit priced cost estimate (based on the current annual contractors bid unit prices) which covers the cost of implementing and maintaining the erosion and sediment control provisions called for in the plan, including seeding of all disturbed areas, has been approved by the County.
 5. Bonding in the amount of the approved cost estimate submitted and approved by Environmental Engineering and in a format approved by the County Attorney has been executed.
 6. Field implementation of any applicable erosion control measures if land disturbance has already taken place.
 7. Evidence, as required as a facet of the appropriate plans approval process, of application for and/or approval of any additional necessary Federal, State, or County permits.
 8. Payment of any outstanding land disturbance re-application fees.
- B. If, after forty-five (45) working days, no action is taken by the Environmental Engineer after receipt of a plan, it may be assumed that the plan meets the conservation standards criteria and specifications as required by the ordinance; however, the forty-five (45) day period does not allow land disturbance permit issuance unless all other requirements, as stated above, have been fulfilled. To proceed with land disturbing activities without a valid permit having been issued is a violation of the Erosion and Sediment Control Ordinance. After the fulfillment of all erosion control ordinance requirements by the owner, he may make application for the land disturbance permit. The land disturbance permit shall be issued by a County subdivision inspector once he has determined that all conditions as included on the permit have been met. The land disturbance permit must be displayed at the entrance to the project in much the same manner as a building permit would be.
- C. Conditions of the Permit
1. A copy of the approved erosion and sediment control plan and narrative shall be on the site at all times and be stamped by Engineering "Erosion Control Approved".
 2. An arrangement between the contractor and developer has been provided in order to allow the contractor to perform maintenance when requested by the County or as specified in the narrative.
 3. A pre-construction meeting has been held and satisfactorily concluded.
 4. Conduct by the contractor in conflict with the provisions of the permit shall be cause for revocation of the land disturbance permit and/or immediate violation status.
- D. Violations
1. When an unauthorized land disturbance has occurred, the County shall notify the contractor and the owner/developer that the violation exists.
 2. Contact via phone call with a follow-up letter shall be sufficient notification.
- E. The construction activities of (1) off-site sanitary sewer construction separately submitted, and (2) off-site water service construction are considered to be individual land disturbing projects, each one requiring its own separate erosion and sediment control approval.
- F. The official approvals for activities 1 and 2 will come in the form of a "release to construction" from the Utilities Department, once an inspection by Environmental Engineering has verified the proper implementation or maintenance of those facilities, which are at or downstream of the area of the proposed utility construction, as shown on the approved erosion and sediment plan and in accordance with an issued land disturbance permit.

III. Clarification of the Exemption Status for Certain Land Disturbance Activities

- A. When a land disturbance activity is exempt, per the Chesterfield County Erosion and Sediment Control Ordinance, it shall mean that the owner of the land does not have to serve notice to the County that his land disturbance activity will take place nor shall he be required to submit plans, siltation certificate, bonding, etc. However, exemption does not mean that any person who owns land in Chesterfield County can willfully suffer or permit any portion of his land to remain in such a condition that soil erosion and sedimentation causes a reasonably avoidable damage or harm to adjacent or downstream property, roads, streams, lakes or ponds. Even exempt conditions may be subject to remediation through civil action by the damaged party. If the public at large is subject to damage, the Environmental Engineer may invoke Sec. 7.2-4 of the Ordinance.
- B. Although no plan, certificate, bonding, etc. is required, the Environmental Engineer may require the implementation of certain temporary sediment control measures, prior to the release of a building permit, on a single family residential structure when site preparation could contribute to the siltation of a drainage course and there are no other protective measures in existence.

IV. Deficiencies

- A. An official violation of the Erosion Control Ordinance, bringing about restrictions, as stated in the Ordinance consists of (1) a failure to comply with an approved plan, or (2) undertaking a land disturbing activity without a valid and displayed land disturbance permit.
- B. With a revoked, unissued, or undisplayed land disturbance permit, the Environmental Engineer's options for actions will range from (1) shutdown of the project, (2) injunctions, or (3) warrant to appear in court. (Once the warrant has been served, court appearance is mandatory, regardless of remediation of violation).
- C. Other actions available to the Environmental Engineer which are used singularly or in conjunction with the above are: (4) a hold on building permit release (uninvolved separate home builders can be held up due to negligence on the part of the subdivision developer); (5) a hold on release of an occupancy permit; (6) non-issuance of land disturbance permit; (7) a hold on the "release to construction" on utility work; and (8) a hold on plat recordation.

V. Erosion & Sediment Control Plan Commentary

- A. A project narrative is a required portion of erosion and sediment control approval. A narrative does not consist of general notes which would be applicable to all projects, but specific instructions as to timing of erosion control implementation coordinated with a specified sequence of construction events. Also, any special circumstances, instructions, limitations, etc., of which the contractor may need to be made aware shall be included in the narrative.
- B. The Virginia Uniform Coding System for Erosion and Sediment Control Practices shall be used to present the erosion and sediment control program on the plan view. The key and symbol for each erosion control measure shall be shown in its approximate location. A separate detail sheet giving the number, title and description along with adequate construction details as portrayed in the Virginia Erosion and Sediment Control Handbook shall be included in the plan package. All non-pertinent details shall be removed or crossed out. It shall not be sufficient to simply refer to the Virginia Erosion and Sediment Control Handbook for the details.
- C. All erosion and sediment control provisions, particularly silt basins, shall have all necessary information (i.e., dimensions, elevations, location tie-towns, etc.) so as to provide the contractor with adequate information in which to construct the facilities per the plan.

- D. Designs and details of sediment basins should be as portrayed in the Virginia Erosion and Sediment Control Handbook, Second Edition, 1980.
1. Risers shall be sized to remain in a weir flow condition for the standard basin design storm discharge. The elevation difference between the riser crest and the emergency spillway shall provide ten-year (existing development) storm capacity.
 2. Risers in sediment basins shall be non-perforated in accordance with STD. & Spec. 1.26 unless a variance is given by the plan approving authority.
- E. Construction plans shall clearly earmark those lots that do not qualify for building permits where major sediment control structures are located (i.e. NBP). The affected lots shall not qualify for building permits until the basin has been removed and the area graded out and seeded.
- F. At least one suitable stockpile location and accompanying erosion and sediment control provisions shall be shown on the plan.
- G. Erosion and sediment control plans which cover utility construction shall include a typical section showing an undisturbed vegetated buffer between the trench and an adjacent creek with the excavated material placed on the side of the trench opposite the creek. Prior to approval, the Plan Reviewer shall determine that the distance of the utility line from the top of bank has been optimized or drainage improvements to accompany the utility construction may be necessitated (see Figure 1).

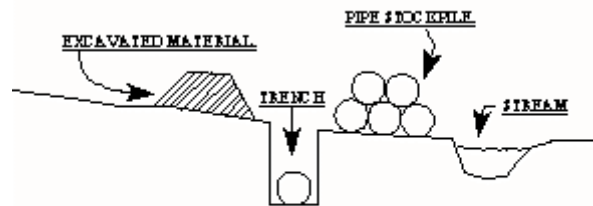


Figure 1
Placement of Excavated Material

VI. Erosion and Sediment Control Field Requirements

- A. Stockpiles, whether pre-existing to the development or as a result of the development, shall have adequate drainage and erosion & sediment control provided. Judicious choice of stockpile locations is strongly encouraged. Stockpiles are not allowed in flood plains or right-of-way stubs. Stockpiles remaining on recorded residential lots must be removed or stabilized prior to State road acceptance.
- B. Land disturbing activity is defined as " ... any land change which may result in soil erosion from water or wind ..." It is the responsibility of the owner to have means to respond to complaints from adjacent landowners when the movement of sediment takes place via wind.
- C. Open ditches, whether in County easements or in VDOT rights-of-way, which do not have adequate lining to provide permanent stabilization and are sources of downstream siltation, are not in compliance with the erosion and sediment control ordinance and are, therefore, unacceptable conditions. The County may require a paved lining of the roadside ditch as the necessary erosion control provision. Inadequately stabilized roadway back slopes shall also be considered unacceptable sources of downstream siltation. Full compliance with the erosion and sediment control ordinance is a prerequisite to State acceptance of the road.

- D. Sediment basin removal shall occur only at the direction of the County once it has been determined that the contributing area is sufficiently stabilized.
- E. Clearing and grubbing, which is the removal of vegetation without the removal of the topsoil, is only an initial phase of land disturbance in the development process. An approvable erosion and sediment control plan must address all phases of construction right up to the point of complete and permanent final stabilization at project completion. Clearing and grubbing plans will not be acceptable.

VIII. Erosion Control for Creek Crossings

- A. A detailed step-by-step procedure to be followed by the contractor installing underground utilities across a major flowing stream is a required component of an erosion and sediment control program.
- B. The procedure will be based on considerations that would be unique to the particular location. However, general guidelines which should be followed in the establishment of this particular procedure are as follows:
 - 1. A pre-construction meeting involving the consultant, Environmental Engineering and Utilities Engineering and Inspection personnel and the contractor who is to implement the stream crossing shall be held to discuss and become generally familiarized with the procedure.
 - a. The detailed step-by-step procedure is to be written by the consultant and is to be either the basis for or the result of the pre-construction meeting (a subsequent meeting at the site of the crossing may be needed if the latter is the case).
 - b. Approval of the procedure and obtaining of a permit is a prerequisite to commencement of the stream crossing.
 - 2. Adequate length hose will be provided on the discharge end of all pumps so as not to discharge either highly silted water or water at erosive velocities into an inappropriate area.
 - a. The optimum location for pump discharge is into an adjacent well-vegetated flood plain area.
 - 3. All disturbed portions of the creek cross section shall be immediately restabilized with Class 1 rip-rap* at a minimum thickness of 18 inches. The side slopes of the restabilized creek cross section shall be no steeper than 2:1.
 - a. In some cases, the engineer may specify a new enlarged cross section at which to restabilize the disturbed area. The rip-rap restabilization of the creek shall not cause the original creek flow line profile to be raised.
 - b. The consulting engineer will calculate the amount of rip-rap necessary to restabilize the existing cross section +10% and include that figure in the erosion control plan. The contractor shall have the rip-rap on the site prior to commencement of the creek crossing. *Average acceptable minimum size - 9" *
 - 4. Diversion pipes should be hydraulically proven to be capable of conveying the flow of water without headwaters greater than its diameter and be of adequate length, as verified by a graphical representation of the creek crossing procedure.
 - 5. If diversion trenches are used to route the creek flow around the area under construction, a polyethylene lining or other suitable protection shall be placed in the diversion trench.

6. Initial damming of the creek will be accomplished by the use of clean stone. Final damming can be accomplished by the placement of an earth dam upstream of the stone dam.
7. The Department of Environmental Engineering shall be notified at least 24 hours in advance of the creek crossing.

IX. Other Erosion and Sediment Control Measures to be Practiced in Chesterfield County

- A. When flushing newly-constructed water lines through fire hydrants, adequate hose length will be provided so as to discharge into stable, heavily vegetated areas or to the nearest rigid lined drainage facility such as a paved ditch, pipe, D.I., or manhole. Discharges should not be directed into existing grassed roadside ditches or back slopes.
- B. Stone filtration dams placed in live streams shall be constructed with a central core of filtering 57 stone surrounded by a structural cradle of larger rip-rap.
- C. Sediment Control Pits are typically specified immediately downstream of defined drainage outlet point from a small disturbed area. This is simply a hole dug by a backhoe to a specified set of dimensions as worked out between the engineer and the plan approver. Factors such as, location and timing in relation to future permanent improvements, removal of the excavated material, or conversion to permanent energy dissipation/ground water recharge facilities shall be covered in the project narrative.
- D. Perforated plywood blockages of the bottom half of existing culverts and storm sewer entrances provide effective sediment control.
- E. Stone "horseshoes" tying into fills from where culverts or storm sewers are projecting provide effective sediment control.
- F. Measure to preclude the deposit of sediment in storm sewers are standard requirements whether specifically called for on the plan or not. These include:
 1. Straw bales or stone berms around excavated holes left for the future inlets.
 2. Incomplete backfill around constructed inlets.
- G. Detention basins may be constructed with certain modifications to function temporarily as sediment basins.
- H. Straw bales or stone check dams shall be placed in ditches where shown on plans or if required by County inspector.
- I. Straw bales, silt fence, and earth berms are not interchangeable. The plan approval authority must be consulted and plans revised if a change is approved by Environmental Engineering.

X. Land Disturbance Permitting Procedures

- A. The following are the procedures to be followed when submitting a Land Disturbance Permit Application. The items are listed in sequential order as they should be accomplished through the process. All steps must be completed prior to any land clearing activity. Items 1 through 7 must be completed prior to permit application processing. **Permit application processing is not a "walk-thru" process.**
 1. Submit a Program Administration Fee (commonly referred to as the "review fee"). The Program Administration Fee may be paid at time of plan submission, but must be paid prior to plan review.

- a. For Commercial Site Plans of less than 10,000 square feet of disturbed land: **\$100.00.**
 - b. For Commercial Site Plans of greater than 10,000 square feet of disturbed land: **\$1,060.00 plus \$50.00** per disturbed acre per plan submitted.
 - c. For Residential Development Plans of greater than 10,000 square feet of disturbed land: **\$1,060.00 plus \$50.00** per lot per plan submitted.
2. Submit plans for appropriate review process (Residential or Commercial Site).
3. Approval of submitted Commercial Site or Residential Road and Drainage Plans.
 - a. All Commercial Site Plans require a final approval letter issued by the Chesterfield County Planning Department.
4. Submit two (2) extra copies of the approved plan to be stamped by the department review engineer. Once stamped, these plans are to be delivered into the possession of the erosion control contractor and the owner, respectively.
5. Submit a check, letter of credit, cash, or bond as surety for the erosion control measures identified in approved plan.
6. The owner of the property must submit a Land Disturbance Permit Application in the Department of Environmental Engineering. The application must be completed in full and notarized.
7. Once the permit has been processed in the department, the owner shall arrange for an on-site pre-construction meeting between the application specified erosion control contractor and the appropriate Environmental Engineering Senior Construction/Drainage Inspector.
8. At the conclusion of the successful on-site pre-construction meeting, the department inspector will physically issue the Land Disturbance Permit for the project. A copy of the permit must be posted at the site at all times.

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CHESTERFIELD COUNTY LAND DISTURBANCE PERMIT APPLICATION

OWNER/DEVELOPER SECTION

I, _____, hereby certify this _____ day of _____, 19____ that:

1. An Erosion and Sediment Control Plan ("Plan") has been submitted with the site or subdivision plan to the Chesterfield County Environmental Engineer as required by the Chesterfield County Erosion and Sediment Control Ordinance.
2. I am the owner of the following described property; and am solely responsible for carrying out the Plan.
 - a. Subdivision/Project Name: _____
 - b. Location: _____
(address/road frontage
and distance to inter-
section) _____
 - c. GPIN Number: _____
 - d. Magisterial District: _____
 - e. Intersection road Name and
State Route Number _____ SR#(_____) _____
3. I shall be responsible for the proper performance and maintenance of the Minimum Standards (1-19) along with the erosion and sediment control measures included in the plan.
4. I shall conform to the provision of Article 4, Chapter 5 of Title 10.1 of the Code of Virginia, 1950, as amended and the Chesterfield County Erosion and Sediment Control Ordinance.
5. I, _____, (signature) hereby grant the Environmental Engineer of Chesterfield County or his designated agents the right to enter my property, subject to the Land Disturbance Permit herein applied for, to inspect or monitor for compliance with the provisions of the permit on the above referenced project.

In the event that measures for the control of siltation and/or erosion as provided for in the "Plan", or in any approved modification thereof are not constructed and siltation and erosion results, or are constructed, but fail (through overload and/or inadequate maintenance) to perform the function for which they are intended, the Environmental Engineer of the County of Chesterfield or his designated agent shall have the right to enter upon the property subject to such plan and shall be entitled to take such measures or to do other work as deemed necessary to prevent further siltation or erosion provided that the County shall first give notice in writing to me or my designated agent for the County's intent to do so.

7. In any event there occurs siltation and/or erosion from the property covered by the Land Disturbance Permit in sufficient quantity to adversely affect downstream properties the Environmental Engineer may hold the below signed responsible for satisfactory restoration.

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8. It is the purpose or intent of this document to insure installation, maintenance, and performance of measures provided for in the approved Erosion and Sediment Control Plan or approved modification thereof.
9. I certify that _____ (contractor) has in his possession, a copy, stamped "APPROVED FOR CONSTRUCTION/ENVIRONMENTAL ENGINEERING" on the Plan dated _____ with revisions dated _____ for _____ (project).
10. I certify that I fully understand the provisions of the Chesterfield County Erosion and Sediment Control Ordinance and agree to carry out the approved Erosion and Sediment Control Plan on the above referenced project.
11. I certify that there is an appropriate contractual agreement between:

Contractor Name: _____

Contractor Address:
(street and mailing) _____

Contractor Phone Number: _____

and myself which established him as the person responsible for carrying out the erosion and sediment control plan and/or providing erosion and sediment control facility maintenance and/or dust control when requested by the County or as specified in the narrative.

12. I certify that all other contractors who engage in land disturbance activity on my behalf will comply with the provisions of the Chesterfield County Erosion and Sediment Control Ordinance and Plan, including not engaging in such activity without the existence of a Land Disturbance Permit.
13. I will authorize commencement of land disturbance activities on the project only when a VDOT Land Use Permit has been issued, if applicable, and there is a valid Land Disturbance Permit displayed on the site.
14. I fully understand that I am subject to prosecution in the General District Court of Chesterfield County when any contractors who engage in land disturbance on my behalf commence or continue to engage in land disturbance without the existence of the Land Disturbance Permit.
15. I understand that failure to comply with the Erosion and Sediment Control Plan or any other violation of the Chesterfield County Erosion and Sediment Control Ordinance shall be cause for revocation of the Land Disturbance Permit.
16. I, or _____ (contractor), will notify the Chesterfield County Environmental Engineering Department Inspector at least 48 hours in advance of the date of a requested pre-construction conference meeting.
17. When a pre-construction meeting has been determined to be necessary by the County, that meeting shall have been satisfactorily concluded prior to issuance of the Land Disturbance Permit.

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18. To the best of my knowledge all applicable wetlands permits which are required by Federal, State, or local laws have been received. A copy of said permits or certification from a qualified wetlands expert regarding the non-notification provisions of NW26 has been furnished to the Department of Environmental Engineering.

BY: _____
(Please Print)

SIGNATURE: _____

TITLE: _____
OFFICER/OWNER/AGENT

ADDRESS: _____
(Street & Mailing)

TELEPHONE: _____

FAX: _____

STATE OF

COUNTY OF _____, to wit:

I, _____, a Notary Public in and for the County and State aforesaid, do hereby certify that _____, whose name is signed to the foregoing and annexed writing bearing date on the ____ day of _____, 19____, has acknowledged the same before me in my jurisdiction aforesaid.

Given under my hand this ____ day of _____, 19____.

My commission expires: _____

Notary Public

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STORM SEWERS

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STORM SEWERS

Unless superseded by conflicting items in this chapter, the following shall be used in storm sewer designs.

All information included in Chapter 4 of the current VDOT Drainage Manual, Section 100 Drainage Items of the Book of Standards, and Section 302 Culverts and Storm Drains of the VDOT Road and Bridge Specifications book are considered a part of this chapter.

I. General Criteria

- A. All available pipe diameters down to a minimum 15" are permissible in County easements.
- B. Only concrete pipe is permitted within County easements. Any location accommodating potential vehicular access shall be Type III (re-enforced).
- C. Although concrete pipe is encouraged for all storm sewer uses within Chesterfield County, the specific material for privately owned and maintained facilities (other than dams for ponds and lakes) whose performance or lack thereof will have no adverse effects on adjacent properties, is optional, but are not to be less than 15" in diameter. Design criteria will be the same as for concrete and "n" values pertinent to the material will be required.
- D. No storm sewer within a County drainage easement will be designed to restrict human, animal, or debris from entering into the system.
- E. Except where VDOT criteria dictates otherwise, storm sewer minimum design will be based on the 10-year storm.
- F. Ten-year storm criteria for a storm sewer shall mean that pipe barrel capacity exceeds the hydrologically established design peak discharge, the hydraulic gradeline elevation at any point in the system will not be at an elevation which would indicate an escape of water from the system (system includes pipes, inlets, and manholes), and that inlet capacities shall be such that there will be no overflow of water to areas outside the right-of-way or parking lot during a 10-year frequency storm event.
- G. A roof drainage plan is a required integral part of all commercial site plans, to include minimum floor. When the Environmental Engineer views a proposed site condition which would in his opinion cause drainage or erosion problems due to downspout discharge, he shall require the plan to be amended to pick up the downspout discharge and provide suitable contained conveyance to a point capable of withstanding the impact of the discharge. For multi-family development, see Multi-family section.
- H. Only storm sewers which operate on gravity flow will be allowed in, or to affect in any way, Chesterfield County Drainage Easements.
- I. Manhole steps are required in all structures 4 feet or greater in depth. This must be stated on pipe schedule.
- J. VDOT standard concrete headwalls or modifications will be required on all exposed pipe entrances or discharge sections of a storm sewer system 30" and larger, and on all diameters when multiple lines are used or when pipe slopes are 15% or greater. Headwaters may be modified as conditions warrant.
- K. Exposed pipe entrances or discharge sections of a storm sewer diameter of less than 30" may require, as a minimum, headwalls or flared-end sections.

- L. No seconds or previously used pipe shall be placed in County easements.
- M. Curb and gutter road designs shall employ the use of inlets and pipe (storm sewer) as the basic outfall mechanism unless otherwise advised by the Environmental Engineer.
- N. Storm sewers shall be used to preclude ditch depths of greater than 3 feet except where the Environmental Engineer determines that the achievement of adequate surface drainage requires an open channel.
- O. Storm sewers are not allowed under any residential structure. Where conditions make such necessary, storm sewers may be installed under commercial buildings with the concurrence and approval of the Engineering Department.
- P. Existing storm sewers or other drainage conveyance systems (e.g., culverts, open channels) in County easements which are found not to meet minimum County standards during the engineering of an upstream proposed development (e.g., min. 10-year criteria cannot be met) shall be enlarged or modified as necessary by the upstream developer to accommodate the design discharges or a detention system by the upstream development shall be required which establishes a release rate no greater than the most limiting hydraulic factor in the existing inadequate system.
- Q. The County has established a maintenance program for storm sewers in single family residential subdivisions to go hand in hand with the VDOT State Secondary Road Maintenance System. However, the storm sewer that a developer is permitted to place in a County drainage easement to accommodate or create conditions which are compatible with his commercial development layout are not part of the county Maintenance Systems. Only when, negligence on the part of the owner has caused other landowners to be detrimentally affected by a breakdown of the overall storm water management function of the easements containing the storm sewer shall the County enter the easement to take minimum necessary action to regain the overall storm water management function of the easement system. (See Easements)

II. DESIGN CRITERIA

- A. The basic engineering procedure for the hydraulic design of storm sewers is the Manning's-Continuity Equation relationship:

$$Q = \frac{1.486}{n} A (R^{2/3}) (S^{1/2}) = VA$$

where the "n" for concrete pipe will be .013.

- B. Storm sewers will be designed by first achieving pipe diameters between points of access whose Manning's equation full flow pipe barrel capacity is greater than the hydrologically determined design discharges generated by its contributing drainage area.
- C. The design of the inlets, which is to its own set of criteria as found in Chapter 4 of the VDOT Drainage Manual and clarified in this chapter, shall have no effect on the design discharges used in the pipe diameter determination.
- D. System capacity will then be checked by utilization of the hydraulic gradeline procedure as outlined in the VDOT Drainage Manual.
 - 1. The velocities Vi and Vo in the hydraulic gradeline calculations are to be reflective of partial flow conditions when applicable.
 - 2. The rim elevation in this procedure is the inlet throat elevation.

3. The HGL calculations sheet shall represent the starting elevation at the discharge point as the first inlet, whether it be .8 diameter of the outfall pipe or some other applicable tailwater depth.
- E. The height of a headwall or fill above a permanent storm sewer entrance will be established, based on the higher of either the hydraulic gradeline elevation at the entrance of the storm sewer or a culvert analysis backwater elevation (the tailwater elevation for the culvert analysis shall be the HGL elevation in the first downstream inlet or manhole). Adequacy is established for the storm sewer design when the elevation of the ponded water during the 10-year design storm does not reach the top elevation of the headwall or other low point leading to a designated overflow route.
1. If a physical "holdback" of the 10-year ponded elevation cannot be achieved, the storm sewer shall be considered inadequate and enlargement of pipe diameters required to lower the 10-year headwater to a feasible containment elevation will be necessary.
 2. Higher ponded elevations from storms of greater magnitudes are permissible to the extent allowed by available upstream channelized containment or legal arrangements with upstream landowners. Top elevations of headwalls or fills leading into overflow swales shall be set based on these various possible limitations.
 3. Unless otherwise approved, the hydraulic gradeline elevation at the entrance of a storm sewer which has some probability of being extended in the future shall be no higher than 80% of the diameter of the pipe entrance from which the extension will proceed.
- F. The profile view of all storm sewer designs shall show the system in continuity, including existing ground, any proposed major changes to existing ground, all inlets and/or manholes plotted to their top or throat elevations, the 10-year hydraulic gradeline (100-year where applicable) any other utilities that may parallel or cross the storm sewer's easement.
1. Profiles of storm sewers on commercial site plans are required whether contained in easements or not.
- G. A 100-year intensity storm shall be analyzed through the 10-year storm design facilities and the route of the runoff surcharge shall be established. If this analysis places any proposed building sites in jeopardy, the 10-year man-made design shall be upgraded to a suitable capacity or to the 100-year flood plain limits or to the 100-year backwater limits which would restrict use within such area will be established. There is no minimum drainage acreage which would alleviate the requirement for this assessment.
- H. All storm sewer systems in county easements shall be designed in tangent sections between structures.
- I. The maximum allowable angle change in an inlet is 90 .
- J. In small residential lot developments the terminus or discharge point of the storm sewer will be established at the point where the crown of the pipe or top of the headwall intersects with existing ground as shown on the profile. That point must be at least 20' beyond the main building structure. Where hydraulically practical, the entrance of the storm sewer system will be established under the same considerations.
- K. When there is a change in pipe size at the manhole, the practice of matching crown elevations of the pipes is a standard practice when not overridden by other more critical factors.
- L. The maximum length between storm sewer access openings (i.e., manholes, junction boxes, drop inlets, open ends of pipe or other approved access appurtenances) shall not exceed 300' for pipe diameters of 30" and less, or 500' for pipe diameters of 36" or greater. These requirements will

not be affected by the velocity and depth of flow consideration as discussed in the VDOT Drainage Manual.

- M. Except at the downstream terminus, a minimum one foot cover from finished ground surface to the top of the pipe will be required in non-traffic areas, otherwise conformance with PC-1 on page 106.05 of the VDOT Book of Standards is required.
- N. Unless approved in advance, no reduction of pipe size in the downstream direction is permitted.
- O. Designs should strive for no new man-made channelized ditches to existing streams. However, when it becomes necessary to outfall directly into the channel, the outfall invert elevation should be as high up the stream bank as possible and both sides of the creek cross-section shall be rip rap stabilized.
- P. The minimum separation between a storm sewer line and a parallel utility line sharing a common easement shall be as specified by the Utilities Department subject to the approval of the Environmental Engineer.
- Q. Rip rap energy dissipation treatment shall be placed at the storm sewer terminus in residential subdivisions only if that point is located within a recorded flood plain or beyond the limits of recordation in a future development area. Otherwise, a riprapped, and if necessary, grouted riprap 10-year cross-section open channel shall be required to extend a minimum of three pipe diameters before a grass lining (assuming acceptable velocity, slope, and depth) would be permitted.
- R. When the on-site storm sewer design (System A) dictates that the adjacent upstream future development drainage must be conveyed, via storm sewer to connect into the System A, the portion of System B located within the on-site boundary limits will be considered part of System A and will be the developer's responsibility to construct and record on-site drainage easements.
 - 1. Inlet and/or manhole structures will be constructed at the rear property line and specially designed and modified as necessary to accommodate the upstream open channel discharges until such time as the storm sewer is extended.
 - 2. If the adjacent future development land is within the tentative approval area of the subdivision or owned by the on-site developer, a minimum 20' pipe stub will be constructed into the adjacent property.
 - 3. If performance of the pipe is not needed until future development takes place, the terminus of the pipe at the property line shall be bricked up and buried.
- S. When it is necessary for a structure to be modified from a standard, the modifications must be clearly portrayed on the plan, e.g. specification of enlarged chamber dimensions for IS-1 inlet shaping or enlargement of gutter and throat opening dimensions to accommodate greater flow than what design standard is capable of handling.
- T. Gutters are an integral part of the standard design of the yard inlets to which they are attached. They shall be shown on plans and constructed in the field unless other arrangements are officially made.
- U. Structures which will be utilized as yard inlets shall have slotted throat openings and gutter pan length and width design based on the hydraulic and field conditions of the individual situation. The gutter shall be a minimum of 2' in length. Grate-type inlets shall not be used in residential developments.
- V. The design for storm sewer facilities which replace an existing natural drainage course shall include a comparison profile of the stream flow lines and top of bank to the extent necessary to show that the storm sewer will create no "humps" in the ground configuration and that points of

access into the storm sewer system are no higher than what is available naturally to the rest of the watershed.

III. IS-1 INLET SHAPING

- A. IS-1 inlet shaping is a modification to the chamber of an inlet which serves to partially approximate a continuation of pipe flow through the chamber, thereby reducing the losses in flow efficiency experienced when the form of liquid flow is expanded, contracted and/or bent within the chamber.
- B. The VDOT Drainage Manual, utilization of IS-1 inlet shaping entitles a 50% reduction to some of the losses due to expansion, contraction, and bending and its use can be critical to the determination of system adequacy. Therefore, the following requirements apply to IS-1 inlet shaping when a 50% reduction of inlet losses are assumed in the hydraulic gradeline calculations.
 - 1. The standard chamber dimensions, as portrayed in the VDOT Book of Standards, are not always able to accommodate the inlet shaping treatment. Therefore, special designs giving adequate chamber dimensions for implementation of proper inlet shaping is necessary.
 - a. The chamber dimensions must be large enough to accommodate a minimum 4" slab dimension on any formed concrete IS-1 shaping.
 - 2. The use of IS-1 inlet shaping will be restricted to below 30" diameters and to situations where one pipe enters the chamber and one pipe exits the chamber, except in the case of where a second lower momentum pipe enters the chamber at an elevation whose invert is higher than the spring line of the higher momentum pipe.
 - 3. The maximum elevation difference between the pipes can be no greater than half the diameter of the smaller of the two pipes.
 - 4. The inlet shaping shall duplicate the bottom half of the inlet pipe to full diameter width and extend across the chamber on a line which will match the spring line elevation of the outlet pipe.
 - a. The flow line shall be a uniform grade from invert in to invert out. IS-1 shall be specified as a part of the structure modification information, e.g., DI-6D MOD. with IS-1 inlet shaping for 24" pipe with a 35° bend. Revised chamber dimensions $L_1 = 4.8'$, $L_2 = \text{standard}$. (Provide detail of graphical design for enlarging chamber dimensions.)
 - b. The dimensions of a rectangular modified chamber are a function of the outside diameter of the pipe. The dimensions of a circular chamber and the inlet shaping design are a function of the inside diameter of two pipes.
 - 5. When a dimension specified for the standard design per VDOT Road Designs and Standards is greater than that found necessary in the graphical design, the greater dimension shall be used.
 - 6. Storm sewers with pipe diameters of 30" and above shall qualify for the 50% reduction in junction losses only when pre-cast manhole tees and elbows are used.
 - 7. The implementation of IS-1 inlet shaping can add significantly to the cost and should be accounted for separately in the itemized cost estimates used to establish the bond amount for the project.

IV. Sag Inlet 10-Year Storm Criteria Clarification

- A. In accordance with 10-year storm criteria as presented in the storm sewer general criteria, sag inlet slots shall be of a length capable of handling the same 10-year design discharge used in the design inflow calculations for the pipe diameter at that point.
 - 1. When Type A inlet nosing is used (roll face C&G), the maximum allowable ponded depth as determined by Fig. 4.6.10.9 Page 4 - 34 of the VDOT Drainage Manual shall be 3.5 inches.
 - 2. When Type B inlet nosing is used (regular 6" C&G), the maximum allowable ponded depth shall be 5.5 inches.
 - 3. Type B nosing may be used on sag inlets with 4" roll face curb and gutter to reduce the required slot length as long as proper curb transitioning from the 4" dimension of the curb and gutter to the 6" dimension of the inlet is provided. This involves holding the flow line through the sag and transitioning from the top of the DI 20 feet in each direction, or until tying into the top of the curb and gutter.

V. Construction Methods

- A. Where stone sub-base is required for bedding due to unstable soils, all storm sewers will be constructed on a minimum 6" sub-base of #57 stone, unless another grade of bedding is required, or it can be shown that another grade is needed. This will be stated in the general notes on the construction plans.
- B. All lift holes and joints shall be sealed by approved methods.
- C. On pipes 30" and larger, the sealing requirement refers to the inside joint (invert to spring line), as well as the outside joint (outside crown to spring line).
- D. Mastic properly placed on entire joint may be substituted for "C" above.
- E. The groove or bell end shall be placed upstream and the tongue or spigot end downstream unless a calculated detention release rate stipulates otherwise. (May also be applied to culverts.)

Energy Dissipation - See Rip Rap Energy Dissipation section in Open Channel Chapter.

CULVERTS

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CULVERTS

All information included in Chapter 3 of the current VDOT Drainage Manual, and Section 100 (drainage items) of the VDOT Book of the Standards, and Section 302 Culverts and Storm Drains of the VDOT Roads and Bridge Specifications book shall be construed as being part of this chapter unless superseded by conflicting items in this chapter.

I. Road-crossing Culvert Criteria (Secondary Roads)

- A. The required culvert capacity shall be such that the head elevation necessary to "push" the ten-year design peak discharge through the pipe barrel(s) does not exceed an elevation that is 18" below the edge of the shoulder.
 - 1. If the road is an only means of access, the culvert capacity during the 100-year storm will limit the head water elevation to the edge of pavement at the road sag.
- B. Culverts shall be of a length capable of accommodating 3:1 side slopes.
- C. Culverts shall be reinforced concrete.
- D. All culverts 30" and larger or their equivalent, and all multiple lines and storm sewers, regardless of size, shall have concrete headwalls or modifications approved by Environmental Engineering, constructed on both ends.
 - 1. When the culvert arrangement requires headwalls with wingwalls, of 42" and above, the roadside ditch shall be directed to the culvert through wingwall slits as shown in Figure 6 with minimum 8' gutter pans where paving is not required to a further extent into the connected roadside ditches.
 - a. The wingwalls shall form a 120° angle with the front face of the headwall.
 - b. The headwall shall be parallel to center line of road.
 - c. Where circumstances dictate that the total slope configuration be considered, the terminus may be located at an appropriate point, as approved.
 - 2. The specification of headwalls and wings shall be referenced to the proper VDOT standard.
 - 3. Unless otherwise approved by the Environmental Engineering, box culverts set in live flowing streams or under existing traveled roads shall be pre-cast.
- E. Any 100-year backwater created by a culvert must be calculated and shown on both the plans and recordation plat. 100-year backwaters totally within easements are not required to be recorded.
 - 1. The construction of any permanent structures shall be a minimum of 20' outside of this area.
 - 2. If 100-year backwaters do not reach an elevation which would cause an inundation of the road, minimum floor elevation for homes adjacent to this backwater area on the upstream side of the roadway fill will be established at a minimum of 1' above the vertical sag elevation in the roadway.
 - 3. A recommended calculation procedure for establishing a backwater area when the 100-year storm inundates the road fill, is found in Chapter 6, Section V (backwater).
 - 4. When lots are to be recorded adjacent to a flood plain which may be affected by the backwater of a future culvert, a minimum standard design (10-year storm for subdivision roads) for that future culvert and road grade shall be established in order to determine the effect on the upstream water elevation during the 100-year storm. If these backwater limits exceed the limits of the present flood plain, the future backwater elevation shall be

the basis for the recorded flood plain limits and minimum floors shall be established accordingly.

- a. If the developer owns both sides of the creek, he may opt for a higher criterion drainage performance by installing larger culverts to minimize the potential flood plain increase on his property.
5. If the culvert design involves an existing recorded flood plain, the design of the culvert and road grade shall be such that those existing flood plain limits are not altered (further explained in the Flood Plain chapter), unless approved by the Environmental Engineer.
- F. VDOT culvert calculation sheets shall be fully filled out with both inlet and outlet control analysis performed.

II. Private Entrance Culverts

A. Within the right-of-way

1. Private entrance culverts on secondary roads shall be sized with a HW/D equal to or less than 1 based on a 10-year storm.
 - a. Design calculations on entrance culverts are to be furnished to the plan reviewer.
 - b. Notwithstanding the above, cul-de-sacs may be designed with appropriate drainage breaks.
2. The minimum size is 15" RCP, unless 12" RCP has been approved in advance for the first culvert adjacent to a drainage break.
3. The bell or groove end of pipe will be on the upstream side; the spigot or tongue end on the downstream side.
4. The proper size entrance culvert for each lot shall be shown in each lot on the plan sheet or in a tabular form. It is not acceptable to make the statement in the general notes, "all entrance culverts are 15", unless otherwise noted".
5. Where it is deemed critical for proper storm drainage design, the specific location of the entrance culvert in relation to the lot it is serving shall be specified on the plan.
6. When an entrance culvert located in an easement or the right of way serves as a part of an overall drainage system, invert elevations shall be specified.
7. The County reserves the right to require the specification of invert elevation on entrance culverts when it deems that a critical and difficult design/construction circumstance would best be served by the provision of that information.
8. All entrance culverts are to be Class III reinforced concrete and are to be placed in conjunction with the VDOT's criteria. The length of entrance culverts shall conform with the latest VDOT standards.
9. Entrance culverts with multiple lines or 30" or larger pipes are required to have headwalls installed upstream and downstream.
10. Entrance culverts must be satisfactorily installed prior to release of the building permit.
11. Developers tying into any existing temporary turnarounds or right of way stubs are required to provide reposition and/or upgrade any existing private entrances with adequate culverts as necessary to achieve compatibility with their road design. If culverts were temporary in a curb and gutter subdivision, curb and gutter will be required.

B. Culverts in County Easements

1. The headwater from a 10-year storm can be no greater than the embankment or the containment ability of the upstream channel.

2. The driveway above the culvert shall not be topped on the 100-year storm if it is to be the only means of access.
3. If no embankment elevation is specified, the HW/D shall be equal to or less than 1.
4. All multiple lines and 30" and above (or their equivalent) culverts shall have concrete headwalls.
5. The minimum culvert length for vehicular access shall be 16'.
6. Only Class III concrete culverts are allowed in County easements.
7. Culverts in easements are privately owned and maintained.

C. Culverts in Other Locations

1. The headwater from a 10-year storm shall not top the embankment.
2. The driveway above the culvert shall not be topped on the 100-year storm if it is the only means of access.
3. The 100-year backwater shall not adversely affect an off-site upstream land owner. (See Backwater)
4. All multiple lines and 30" and above (or their equivalent) shall have headwalls.
5. Concrete shall be used when crossing a live flowing stream.

III. Engineering and Construction Practices

- A. Existing inadequate culverts in county easements and under state roads into which a project drains must be enlarged or on-site detention based on the ultimate development of the contributing watershed provided to achieve minimum 10-year storm performance on the pipe.
- B. Culverts will be designed to function independently. Project design will be such that the 10-year design headwater of a culvert will not reach an elevation where it will "flow over" into the design drainage area of another culvert. Designed berms and/or culvertless private entrances may be necessary to accomplish this.

IV. Placement of Culverts in Natural Channels

- A. Where possible, the design of a culvert shall call for its placement in the creek with no alteration of the existing natural flow line profile, alignment, or width. The plans shall show an existing creek cross-section for comparison with the size of the culvert.
- B. When some alteration of existing natural creek conditions is required in the culvert design, transitional and additional survey and engineering information is needed.
 1. Transitioning when the width of culvert with headwall and wings is wider than existing creek cross-section:
 - a. Plans shall show a dimensional plan view of the point upstream of the culvert where a gentle widening out of the creek cross-section to the width of the culvert shall take place and on the downstream side a gentle narrowing back down to a specified point where the creek would again be undisturbed.
 2. Factors influencing lengths of transitions
 - a. The practicalities of the field.
 - b. The elimination of abrupt creek meanders immediately upstream or downstream of the culvert.
 - c. On the downstream side, the design storm depth at the reacquired natural stream cross-section should be lower than the critical depth of the culvert.

- d. The angle between the front face of the culvert and the transitioned creek bank should not be less than 60 degrees.
- 3. Transitioning when the inverts of the culvert are lower than the existing creek flow line:
 - a. In addition to the plan view, a profile view is required showing the existing profile of the creek and the relationship of the culvert to that existing profile.
 - b. The length and grade of the proposed vertical transitions to their points of intersection with the existing natural creek flow line should be indicated.
 - c. The maximum grade on the upstream transition shall be 10% plus the original stream grade (e.g. maximum grade for original flow line of 2% - 12%). The transition grade on the downstream side shall be no flatter than the slope of the culvert.
- 4. When both vertical and horizontal transitioning are required:
 - a. The type of transitioning (vertical and horizontal) which requires the greatest distance upstream and downstream shall establish the limits of transitioning.
 - 1) If vertical transitioning requires the greatest distance, the vertical transitioning will be affected over the entire length.
 - 2) If horizontal transitioning requires the greatest distance, the vertical transitioning will be affected over the entire length.
 - b. In general, transitioning done in natural water will always be riprapped lined.
 - 1) Concrete will be used in the transition regions between the headwall wings and as stated, in the Open Channel Section.
- 5. In order to keep transition requirements to a minimum, all multiple line culvert arrangements should be positioned symmetrically to the centerline of the stream.
 - a. Odd-numbered multiple culverts will have center pipe barrels slightly lower than the other pipe barrels.
 - b. Even-numbered multiple culverts will have one of the center-most pipe barrels slightly lower than the other(s).

V. Alternative Culvert Designs

- A. Standard procedures in culvert design shall verify enough available head in order to render a culvert adequate to handle the minimum design peak, however, if a volume analysis (routing) of the backwater area indicates that a 100-year storm would not top the road, the County of Chesterfield would condone a reduction of pipe size down to a point which would still not allow a topping of the road on the 100-year storm under the volume consideration. The following guidelines apply:
 - 1. Culvert must be concrete and have full headwall and wingwall arrangements in order to minimize the buoyancy tendency.
 - 2. Any filling or other activity that would reduce the storage volume would have to be legally forbidden by a restriction on the recordation plat.
 - 3. VDOT shall approve the construction plans.

VI. Bridges as Alternatives to Large Culverts

- A. This Department does not approve the design for any bridge, the Building Inspection Department releases a separate building permit for the construction of a bridge.
- B. The calculated hydraulic performance of the drainage conveyance over which the bridge passes shall not be affected by the bridge during any frequency storm.

VII. The use of HEC#13 (Hydraulic Engineering Circular #13) for improved inlets on culverts is encouraged as an extremely effective cost-saving procedure.

- A. ES-1 flared end sections do not increase the hydraulic capacity of culverts. They are less efficient than a standard groove end.

VIII. Energy dissipation - Energy dissipation is a means of dissipating energy by reducing velocity and can be achieved through numerous ways.

- A. Placement of riprap 18" thick.
- B. Placement of riprap 18" thick with filter fabric lining.
- C. Discharging into natural rock areas.
- D. Discharging into pools of water (i.e. lakes and ponds).
- E. Discharging below the surface of a pond or lake (Note: this would affect the HGL).
- F. Riprap will not be used in front of or beside any residential lots zoned less than R-25. In R-25 and larger, homes must be naturally buffered from area of use by 50'.

The outlet of all culverts shall have the appropriate size riprap installed downstream from the outlet end of the culvert or from the paved apron between the wings.

Distance:

- a. 3 times the diameter of single barrel pipes.
- b. 3 times the outside distance on multiple lines.

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DRAINAGE DISTRICTS

- I. General** - Establishment of specific Drainage Districts is authorized and defined by County ordinance. Please see Chesterfield County Code, Chapter 17, Article III, Division I, Section 17-63 for specific citations.
- A. The drainage district is a means by which the developers, within a particular watershed, can combine forces on an equitable economic basis to implement drainage improvements of common need and benefit to all, but which are beyond the economic and management scope of what could be handled by any one developer.
 - B. Since the development of the watershed, the amassing of funds, and the implementation of drainage districts improvements may take place over a long period of time, the County provides the central long-term management program for the district.
 - C. The purpose of a drainage district is not to help defray the costs of large drainage structures incurred by a developer, whose land has a large upstream drainage area, but is to provide the means by which large scale engineering and construction challenges can be met by the private sector with the help of the local government. This can enable large areas of previously undeveloped land to be utilized to the benefit of not only the individual owner, but also to the citizens of Chesterfield County through the expansion of the tax base.
 - D. The drainage district concept is usually a desirable alternative to large scale capital improvement projects or bond issues financed by the public-at-large. Instead, the specific users in the private sector are afforded an equitable means by which to share the burden of a costly investment so that common future economic benefits from development of the area may be realized.
- II. Establishment of a Drainage District** - The Environmental Engineer shall, when he deems it to be in the best interest, recommend to the Chesterfield County Board of Supervisors the legal formation of a drainage district after the following conditions and/or procedures have been met:
- A. A large poorly-drained watershed exists made up of a significant number of individual undeveloped parcels. In preliminary studies, it is realized that the development of most parcels in the watershed would require extensive and costly off-site improvements and easements, not only to provide adequate drainage away from the developing sites or to protect other parcels from flood damage, but to achieve adequately lowered inverts for the drainage improvements accompanying the development of upstream areas.
 - B. Therefore, improvements on an overall watershed basis are found to be the only feasible means of providing adequate drainage for development. Since every parcel to be developed in the watershed contributes to the increased runoff which would be handled by the drainage improvements and/or benefits from the improvements, a system (drainage district) to equitably share the high cost of the drainage improvements is available.
 - C. The potential development trend of the area must be predominately that of a commercial or manufacturing nature, or any type of development which could enhance the County's tax base, in order for the County to be willing to take on the burden of the management of a drainage district.
 - 1. Residential development generally does not enhance the tax base.
 - D. An initial drainage study, usually financed by the initial developers in the proposed district, will be performed by a consulting firm chosen by the County who will:

1. Establish the limits of the proposed drainage district (based on the drainage area contributing to the proposed improvements upstream of a particular point). The actual boundary of the district shall be established at time of individual site development by field locating the ridge line of the drainage area. The drafted outline of the district shown in the consultant's study or on County zoning maps is for district awareness only and may not be entirely accurate for engineering or pro rata assessment determination.
 2. Establish the acreage of the undeveloped property within the proposed district which will be subject to the pro rata assessment.
 3. Establish a weighted runoff coefficient on the undeveloped properties based on the best estimate of the ultimate development trends, as indicated by the most recent County land use and transportation plan for the area.
 4. Provide a cost estimate of improvements to be implemented as part of the district.
- E. The point of adequate outfall and the upstream limits of the district drainage system will be established by the consultant, however in no case will the district drainage improvements be provided any further than the downstream most property line of the upstream most parcels in the district.
- F. The drainage facilities covered by the pro rata share assessments shall be designed to include only those facilities which provide overall outfall relief for the watershed and not facilities which provide on-site drainage.
- G. Although all phases of the development of the drainage district are, in theory, paid for by private funds, the County Environmental Engineering Department shall oversee the preliminary feasibility studies, the development of the construction plans, and the presentation before the Board of Supervisors for their official approval. This will enable the Department to legally require the pro rata share assessments from the individual parcels within the watershed as they develop.
- H. Once approved by the Board of Supervisors, the limits of the drainage district become legal boundaries. All land within is subject to the pro rata share assessment, if developed. Therefore, the inclusion of land in a drainage district is due to its geographical location as much as a drainage consideration.
1. This means that an individual site drainage alternative which would route the drainage to an outfall facility other than that provided by the drainage district, or a reduction of the amount of water theoretically leaving the site through on-site detention, does not necessarily alter the required monetary assessments.
 2. Only in those cases where it can be shown by the developer that an on-site drainage alternative significantly reduces the actual overall construction cost of the unconstructed portion of the drainage district facilities, would a reduction in an individual pro rata share assessment be considered.
- I. The formation of a drainage district shall be deemed in the public interest and, therefore, any easements which may be necessary to implement the said improvements, if not willingly conveyed to the County through mutually agreeable terms, can be acquired by the process of eminent domain.
- J. In those cases where the proposed improvements and easements are located on the property to be developed, the conveyance of those easements to the County of Chesterfield and bonding for the required construction of those improvements within, will be a prerequisite to any recordation or release of any building permits, where applicable.

III. Establishment of the Pro Rata Assessment Figure

- A. The pro rata share assessment of each individual development will be based on a ratio of the acreage multiplied by the runoff coefficient for the individual developing site (numerator), over a given constant established by multiplying the total acreage of the drainage district by the weighted runoff coefficient for the district (denominator). This percentage multiplied by the total cost of the project determines the cost of assessment at the time of the original estimate.
- B. To account for inflation, the construction cost index factor listed in the Engineering News Record magazine at time the cost estimate for the district improvements as worked up by the district's consulting engineer shall be recorded and used as the denominator of a ratio (present cost index/original cost index) to which the overall drainage district construction costs will be based. In this way, an accurate up-to-date indication of the cost of the drainage district project can be maintained. Since this factor will be applied to the individual assessments and previous assessments are held in an interest bearing account, a financial shortfall in covering the ever increasing cost of construction will, in theory, be avoided.
- C. The runoff coefficient used to establish the monetary assessment may not necessarily be that which was used in the actual on-site drainage design of the site. The runoff coefficient used in the assessment calculations shall not be lower than that which was assumed in the establishment of the overall drainage district weighted runoff coefficient in the original drainage study.
- D. Example Calculation:
- Drainage district = 1000 acres
 - District proposed land use made up of varying densities of industrial and commercial uses resulting in the establishment of a .75 weighted runoff coefficient (C).
 - District drainage improvement cost estimate = \$1,000,000.
 - Engineering News Record (ENR) construction cost index at time of cost estimate July 1, 1985 = 1000
 - Proposed project = 10 AC mini storage facility
 - Runoff coefficient for mini storage = .95(C)
 - ENR construction cost index at time of plan review = 1500 (July 1, 1996)

Pro Rata Formula:

$$\left(\frac{(\text{site ac.})(\text{site } C)}{(\text{district ac.})(\text{district } C)} \right) (\text{Original Cost}) \left(\frac{\text{ENR index (present)}}{\text{ENR index (original)}} \right) = \text{Assessment}$$

Using the above formula, the required assessment is calculated:

$$\left(\frac{(10)(.95)}{(1000)(.75)} \right) (1,000,000) \left(\frac{1500}{1000} \right) = \$19,000.00$$

IV. Payment Procedures of the Pro Rata Assessment

- A. Subdivisions/Road Dedications
1. The pro rata share assessment figure will be established at the time the final plan is approved.

2. A letter showing the calculations deriving the assessment figure will be sent to the developer with payment of the assessment required in conjunction with but prior to the recordation of the plat.
3. The assessment figure provided is valid for a period of sixty days; upon expiration, the figure becomes void and a new pro rata share assessment must be recalculated based on the most recent Engineering News Record construction cost index.

B. Sites

1. The pro rata share monetary assessment will be determined at the time of review of the site plan by the Environmental Engineering Department.
 - a. As a part of the assessment establishment process, a study will be made of the site plan limits as compared to the boundary of which it may be a part. If the residual piece of property remains, which, in the opinion of the County, does not have adequate size, shape or topography to support any additional development (e.g. a comparable additional building in conformance with setbacks and adequate parking facilities), the acreage used in the assessment calculation will include the residual area.
2. Runoff coefficients used in the assessment calculations will be typical of those generally listed for the particular zoning involved; not necessarily that which would accurately reflect a lowered density of the development initially taking place.
 - a. This is to allow freedom of use and additional improvement of the land without the requirement of additional pro rata share assessments at a later date.
3. The assessment figure shall become void sixty (60) days after it has been provided to the developer. After such time, a revised construction cost inflation factor will be applied to the calculation to establish a new assessment figure valid for another sixty (60) days. Payment of the pro rata share assessment is a prerequisite to the approval by the Engineering Department of a building permit application.

V. Drainage District Strategies

The size, timing and location of a proposed development, within the drainage district, will have a significant bearing on the drainage district requirements placed upon it.

- A. Project Developer may be required to pay his pro rata share and develop under approved engineering drawings which show that his improvements are compatible with the future drainage district improvements.
- B. Project Developer may be required to pay his pro rata share and develop under approved engineering drawings which properly tie into existing drainage district improvements.
- C. Project Developer may have a portion of the unconstructed drainage district improvements located on his property and would thus be required to construct the drainage district improvements along with development of his property.
 1. The cost of constructing those improvements would be compared to his pro rata share assessment. The developer would only be responsible for a pro rata share assessment greater than the cost of the drainage district improvements required.
 2. If the costs of the improvements are greater than the pro rata share assessment, the Developer would be subject to a non-guaranteed refund, at a later date, after the

construction of the district project has been fully completed and other succeeding developers are assessed.

- D. Project Developer could be located at a downstream point in the drainage district watershed such that a major portion of the drainage district improvements are required within his development.
 - 1. Developer must decide if he can afford the major expense of construction with the understanding that refunds may be forthcoming as future development upstream, also utilizing the facility, takes place; or
 - 2. Decide to wait until other developments are proposed so that their assessments can help share the expense of construction of the drainage district facilities.
- E. Developer is an initial developer in the drainage district and puts up the money to pay the initial cost of the engineering studies and design proposals.
 - 1. The engineering costs are an integral part of the total cost of the drainage district and, therefore, the assessments are also designed to include those costs.
 - 2. Developer would get full credit off his assessment for the payment of the initial engineering fees.
- F. Developer owns previously developed acreage in the watershed which was, therefore, not included in establishing the drainage district weighted CA, but was considered in the hydraulic design of the district drainage improvements.
 - 1. Developer would be subject to an assessment based on the acreage or square footage of any improvements to his property which would increase its imperviousness (e.g. building addition, addition to existing parking facilities).
 - 2. Payment of the drainage district assessment is required prior to release of any permits or approvals of any kind.
- G. Developer owns land through which the outer boundaries of the drainage district passes. Through the use of storm sewer, he drains the entire project in the direction that the area outside the district drains.
 - 1. Developer would still be required to pay his pro rata share based on the acreage within the district. Otherwise, the established assessment calculations used to determine what other developers have or will pay would no longer be valid.
 - 2. Also, once the district has been legally established by the Board of Supervisors, the inclusion in the drainage district is on the basis of geographical location and not a future storm sewer design.
- H. Developer has obtained a residential zoning for his project and this is in conflict with the County land use plan and the assumptions which were made in establishing the overall drainage district weighted runoff coefficient.
 - 1. If effected district facilities have already been constructed, Developer would still have to be assessed based on the runoff coefficient assumed for the projected nonresidential development of his property.
 - 2. If effected district drainage improvements have not yet been constructed, Developer may opt to perform a drainage study at his expense to see if proposed district facilities can be reduced, thereby allowing for a modification of his pro rata assessment.

The above are examples and do not necessarily reflect all scenarios that are possible within a drainage district.

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OPEN CHANNELS

All information included in the current Virginia Department of Transportation Drainage Manual pertaining to open channels will be utilized unless superseded by conflicting items in this chapter.

Normally the design engineer has the leeway to design a subdivision or site utilizing any type of drainage devices, as long as they meet established design criteria. However, due to open channels being on the surface, significant criteria enter into the design that are not a strict function of engineering and are more a function of the size of lots, location of houses on the lots, as well as strategically located surface flow devices.

I. GENERAL CRITERIA

- A. All ditches shall be designed with the depth not exceeding 2' unless the slopes are laid back to a 4:1 or flatter ratio.
- B. The design depth of all ditches shall be designed to contain the 10 year storm.
- C. There shall be no coverings of any type overtop of open ditches. Small bridges and other bridges will be permissible as long as they are above a 10 year design depth, however, they will be the responsibility of the property owner.
- D. Open channels adjacent to driveways in small lot subdivisions must have the side slopes above the 10 year design no steeper than 3:1.
- E. All ditches shall have the typical section with dimensions shown on the plan view, as well as the profile.
- F. No ditches can be eliminated, piped or otherwise altered without prior written approval of the Director of Environmental Engineering.

II. PAVED DITCHES

- A. Where a paved ditch exits the right-of-way at a culvert, there will be 4' roadside stubs shown on the plan perpendicular to the paved center line to pick up roadside drainage.
- B. In those instances where the culvert or ending storm sewer system enters a paved ditch and due to design is not as wide as the outer diameter of the pipe, a transition section must be shown, along with a detail. This transition section should be at least 10' in length.
- C. Where outfalls are steeper than 15% grade, anchor lugs shall be shown on the plans, one (1) per every other 10' section.
- D. On paved ditches where abrupt vertical grade changes take place and paved ditches change typical sections, a transition must be shown on the plans with a minimum length of 10'.
- E. Where horizontal grade changes occur and freeboard is required, free board shall be shown in the form of an 8" vertical curb on the outside of the radius and shall start at the beginning of the radius and continue through to 15' into the tangent section. This location shall be shown on the plan view. A detail shall also be supplied on the appropriate sheet.
- F. All paved ditches shall terminate into some form of adequate energy dissipation device. This could be in the form of natural rock, low velocities achieved through flat grades, plunge pool, riprap, or any other device which is deemed appropriate by the Director of Engineering.

- G. No ditch paved or otherwise shall be designed in easements where the longitudinal slope is less than 0.2%.
- H. Where trapezoidal paved ditches are used and the longitudinal slope is less than 0.75%, the cross slope on the bottom of the paved ditch shall have a fall of 1" per foot to one side or the other, dependent upon horizontal grade changes. A detail must be shown.
- I. All ditches, to include roadside ditches, between 0.75% and 0.2% will be paved.

III. RIPRAP DITCHES

- A. Riprap ditches will not be utilized in man-made channels located in front of single family homes or beside single family homes, unless the lots are one acre in size or greater. Then they must be no closer than 100' to the dwelling.
- B. Riprap channels can be used to the rear of a small lot subdivision if the recorded plat shows rear building lines of at least 75' from the easement.
- C. Riprap can be used in all subdivisions to stabilize existing creeks in which we have natural stream degradation, or in the creeks where sewer lines have crossed for restabilization.
- D. All man-made riprap channels shall have a filter fabric lining of the appropriate material between the soil and riprap that is capable of allowing water infiltration into the soil, but retarding the dislodging of the soil particles.
- E. On both the plan view and the profile view where the typical section for the riprap channel is shown, there shall be five (5) dimensions.
 - 1. The ultimate design depth and width for containment.
 - 3. The outside construction depth and width of the earth channel prior to placing the filter fabric and riprap. This extra dimension will be the dimension that the contractor constructs the channel to so that, after the placement of the stone to its proper thickness, the design depth and width will be achieved.
 - 3. Riprap thickness.
- F. All riprap channels shall be placed in 2 or 3 layers in order to obtain the required thickness.

IV. GROUTED RIPRAP

- A. When grouted riprap is used, the requirements will be the same as for riprap and will appear on the plan view of the plans with the appropriate legend showing the difference between the grouted and riprap portions.
- B. Grouted riprap, when installed, must be installed such that all voids are totally eliminated in the riprap through the use of grout. After placing the grout, the grout will be lightly brushed into the voids to obtain as smooth as flow as possible.
- C. All grouted riprap channels shall be placed in 2 or 3 layers in order to obtain the required thickness.

V. GRASS CHANNELS - Grass channels will be considered to be grass only, grass and jute mesh, or grass and excelsior.

- A. These ditches can be used when the grade exceeds .75%, but the velocities are less than 2.5 cfs.

- B. These channels shall be designed with a depth not to exceed 2', with maximum side slopes of 2:1 for the design depth.
- C. Trapezoidal earth ditches will not be approved unless the grade exceeds 1.5%.

VI. SYNTHETIC LINED DITCHES (Miramat/Enkamat)

- A. The use of these two synthetic products is various in nature. Normally they are used in those instances at lower velocities to replace paved channels. If used, whether in roadside ditches or County easements, the County must be supplied with a letter from the manufacturer's sales representative that the product has been installed per the specifications.
- B. When installed, it will be installed using the manufacturer's specifications for filling the voids with topsoil, not just the placement on the ground and seeding.
- C. These products can be used in areas that function only during storm events.

VII. FUTURE SYNTHETIC PRODUCTS

Any future synthetic products proposed to be used in the County must first be approved by the Director of Environmental Engineering for a specific use in a specific location. After installation, a letter from the manufacturer and sales representative stating that the new product has been installed per the specifications will be required. Depending on the function and the use of the product, it will be monitored over the following years by the department's drainage section after State acceptance or final Certificate of Occupancy for a commercial site. If it is determined that the product is not functioning as designed, the product will not be allowed to be used until the problem has been corrected. If the product has been found to be installed and functioning properly, after years of experience, and at the discretion of the Director of Engineering, the requirement of installation certification by the manufacturer and the representative may be dropped.

CHESAPEAKE BAY PRESERVATION AREAS

BACKGROUND

In 1987, Virginia, Maryland, Pennsylvania, and the District of Columbia signed an agreement to clean the waters of the Chesapeake Bay as it was realized that this estuary was a barometer of the health of our environment.

In 1988, in response to this agreement the Virginia General Assembly enacted the Chesapeake Bay Preservation Act (CBPA). The act was specifically designed to protect and improve the water quality of the Chesapeake Bay and its tributaries. The CBPA established a Chesapeake Bay Local Assistance Board with a Local Assistance Department to provide a technical staff for the board. The Chesapeake Bay Local Assistance Board and Department were made responsible for developing a process whereby local governments in the designated tidewater area would be required to adopt local land development criteria to limit the volume of pollutants discharged into the waters draining to the bay.

From the act and regulations that were adopted by the State in September of 1989, Chesterfield County adopted an ordinance and related implementation program to meet the requirements.

A. The County Ordinance is based on the following concepts:

1. The entire County is a Chesapeake Bay Preservation Area (CBPA).
2. Resource Protection Area (RPA) lines can be re-defined at time of development.
3. A water quality impact assessment is required for any development in the RPA.
4. The 100' conservation areas may be reduced to 50' if a BMP is designed to compensate for the reduced pollutant removal capability of the RPA.
5. The entire county outside of the RPA is in a Resource Management Area (RMA). The developer may opt all or a portion of his property out of the RMA if it does not exhibit the qualifying characteristics.

MAPS AVAILABLE FOR PURCHASE:

1. 1"=2000' and 1"=4000' scale maps that coincide with the same areas as the land use and transportation plan.
2. 1"=300' scale maps
3. 1"=200' scale maps

Boundaries on all maps show the limits of the RPA's and were derived from either:

1. The 100-year flood plains that have been previously provided through the Corps of Engineers
or
2. In those areas where the 100-year flood plain information did not exist, the hydric soil limits were used in the delineation of the RPA's.

Note - the RPA limits shown on the 1"=800', 1"=2000' and 1"=4000' maps do not include the 100' conservation area.

CHESAPEAKE BAY PROTECTION AREA (CBPA)

The CBPA consists of two areas, the Resource Protection Area and the Resource Management Area.

- I. Resource Protection Area (RPA) - The RPA consists of:
 - A. Tidal wetlands
 - B. Nontidal wetlands connected by surface flow and contiguous to tidal wetlands or tributary streams.
(As defined in Chapter 19, Article VI, Section 19-301 of the County Code)
 - C. Tidal shores
 - D. A vegetated conservation area not less than 100' in width located adjacent to and landward of the environmental features, and along both sides of any tributary stream.
- II. Resource Management Area (RMA) - The RMA consists of:
 - A. 100-year flood plains
 - B. Highly erodible soils
 - C. Highly permeable soils
 - D. Non-tidal wetlands not included in RPA's

Note - A RMA not less than 100' in width shall be located adjacent to and landward of every RPA even if environmental features listed above are not present.

BOUNDARY ADJUSTMENTS:

- I. Resource Protection Area (RPA):
 - A. The 100 yr. flood plain and a 100' conservation area may be used to establish the RPA.
 - B. A qualified expert may field delineate the limits of the wetlands to further refine the RPA.
 - C. Once the wetlands have been field delineated, mapped, and tied down, then a 100' conservation area would be projected from and parallel to the wetlands. This must be certified to the Department of Environmental Engineering by a qualified wetlands expert.
 - D. A 50% reduction of the conservation area may be permitted if a BMP is designed to compensate for the reduced pollutant removal capability of the RPA. *Note - It is at this time that a comparison must be made between the County Code 19-55 et. al. FLOODPLAIN DISTRICT's (residential, 20' horizontal setback from the flood plain), and the Chesapeake Bay requirements (worst case setback and restrictions would prevail).*
 - E. Qualified Wetlands Expert: One who has performed at least three (3) wetlands delineations and has had them approved, in writing with documentation, by the Corps of Engineers. If an engineering firm wants to do delineations and does not have a previous history of approval by the Corps, they can still perform the delineation, but must have it approved by the Corps of Engineers

at least for the first three projects prior to submission to the county. Documentation must be supplied to the County.

- F. Uses in RPA's: Please see exemptions listed in the ordinance. If not exempt by right, only water dependent facilities will be permitted. All BMP's and erosion control devices are permitted within the RPA. When a wet pond is created by damming a tributary stream, a 100' conservation area measured from the lake edge or wetlands (if any) is required. This may be reduced to 50' if compensated for in BMP design.

II. Resource Management Area (RMA):

- A. Opting Out: Due to the large diversity of soils within Chesterfield County and the guidelines presented by the Chesapeake Bay Local Assistance Board (CBLAB), the County has designated all areas which are not RPA's as RMA's. One has the option to certify to the county that the environmental features, as imposed by the CBPA for the RMA, are partially or totally non-existent within the project. These areas would have to be mapped and shown on the appropriate plan sheet (not record plats). *NOTE - A 100' RMA must be maintained adjacent to all RPA's.*
- B. Qualified Expert: A qualified expert for opting out of the RMA may be a qualified engineer who has demonstrated experience with soils, a certified soils scientist, a combination of both, or at a minimum, a soils scientist certified through any national or state certification program, or degree in soil mechanics.
- C. Uses in RMA's: Any zoned use which is in compliance with water quality requirements is permitted.

REQUIREMENTS

I. Subdivisions

A. BMP Types Permitted:

1. Extended detention
2. Wet pond - A wet pond can be used if the pond exceeds ½ acre in size and is spring fed, or has a drainage area of 10 acres.
3. Infiltration - Infiltration devices can be used only when:
 - a. The field verified soils indicate they will support this type of BMP facility. This must be certified by a soil scientist.
 - b. When, due to topography and other extenuating circumstances beyond the developer's control, other BMP's are not feasible.
 - c. Infiltration trenches, if allowed, must be designed and maintained for the entire subdivision and not for individual lots. *NOTE - Chesterfield County soils are not generally supportive of this type of design.*

B. BMP's Types Not Permitted:

1. Restriction of impervious areas by recorded plat.
2. Grassed swales.
3. Riprap check dams.
4. Filter strips.
5. Sand filters (subdivisions).
6. Infiltration trenches on individual lots.

C. Existing Single Family Lots:

1. Lots recorded prior to the enactment of the Chesapeake Bay ordinance may use, as a BMP, an infiltration trench as a BMP on individualized lots. However, this concept will not be used for subdivisions recorded subsequent to the enactment of the Chesapeake Bay Ordinance.
2. If open space exists within a recorded subdivision section, then the number of acres of open space will be equally divided between all lots that have not had a building permit application approved by the Environmental Engineering Department as of the ordinance enactment date.
3. When an existing single family lot must comply on its own, an improvement sketch must be submitted with the building permit application. The improvement sketch must include a scaled version of all exact dimensions, to include exact location and dimensions of house, driveway, sidewalk, and any other impervious areas. Also to be included would be flood plains, RPA's, easements, etc. The percent imperviousness will be the footprint of the house, all sidewalks and all drive- ways, to include turnarounds, be they stone, asphalt, concrete, etc. (see Appendix B)

D. Compliance Procedures:

1. Tentative: It is at the time of the Planning Commission or administrative tentative approval process that the developer must provide Chesterfield County an accurate estimate of the post- development phosphorus loading on a total project basis. One must also show that there is a means available to install the appropriate devices so that the project does not exceed .44 lbs/Ac/yr for residential and .50 lbs/Ac/yr for commercial phosphorus loading without requiring the tentative to go back before the Planning Commission.
 - a. A complete tentative application must include a preliminary CBPA plan so the Environmental Engineering Department can make a recommendation to the Planning Commission or administrative staff.
 - b. The RPA must be shown on the overall tentative plan, to include the 100' conservation area.
 - c. One must submit concurrently to Environmental Engineering, but on the same tentative, the location of proposed BMP's and corresponding drainage areas (preliminary CBPA plan).
 - d. A proposal to show the RPA with less than the 100' conservation area must be approved by the Environmental Engineering Department through the preliminary CBPA plan approval process.
 - e. Accompanying the preliminary CBPA plan would be the appropriate worksheets which support the post-development phosphorus loading and, in turn, the BMP's required to achieve the pollutant removal percent efficiency so as not to exceed, .44 lbs/Ac/yr for residential and .50 lbs/Ac/yr for commercial, phosphorus runoff required for tentative CBPA plan approval.
 - f. Basins would be sighted on the preliminary CBPA plan utilizing the approximate volume and estimated surface area so that it is compatible with the roads and lot layout. ***NOTE: This is a worst case scenario and at a later date the engineer may opt out portions of the subdivision from the RMA which, in turn, could permit down- sizing the facilities. This can take place when the actual designs are submitted with the road and drainage plans.***
 - g. If proposed BMP's shown on the preliminary CBPA and plan are to be located in existing easements (e.g. Virginia Power, etc.), written approval

from the easement holder must be obtained prior to the Environmental Engineering Department giving preliminary CBPA plan approval to the project. ***Note: If the developer would prefer to put this requirement off as a prerequisite to recordation, a written letter from the developer stating so must be submitted to Environmental Engineering prior to preliminary CBPA approval.***

- h. Approval of a preliminary CBPA would constitute general Chesapeake Bay project approval.
- i. General Chesapeake Bay approval is a prerequisite to a recommendation by the Environmental Engineering Department for approval of the tentative subdivision by the Planning Commission or staff. ***Note - There are some situations that an engineering design with more exact data may still involve referral to the Planning Commission.***

2. Construction Plans:

- a. Construction plans must show the RPA line (to include the conservation area) when the development is affected by a "tributary stream".
- b. If wetlands have been field located and the RPA adjusted accordingly, the wetlands must be shown and the proper documentation received.
- c. Construction plans must show all BMP's which are to be constructed with the section to be developed. The implementation process of project BMP's must begin with the initial phase of development and continue on an "as serve" basis as subsequent phases of development occur.
- d. All pertinent information as to grading of the basin, standpipes (concrete), elevations, dimensions, etc. must be shown in the appropriate place on the construction plans. Scale to be 1"=20'.
- e. The applicant shall submit the necessary calculations associated with the BMP design. ***Note: If one chooses to opt out of a portion of the RMA and has submitted certification by a qualified expert, then those areas must be delineated on the construction plans (not required on record plat).***

E. Final Check Plat/Recordation Plat:

1. Prerequisites:

- a. If the easement for the BMP facility is not being recorded within the limits of the first subdivision section that requires such a device, then an easement suitable to the County must be recorded by separate instrument prior to, or in conjunction with, plat recordation.
- b. Prior to recordation of any subdivision, the appropriate BMP indemnification agreement must be approved by the County Attorney as to form; approved by the Board of Supervisors; signed by the County Administrator; recorded and a recorded copy with the deed book and page number given to the Environmental Engineering Department. (see Appendix A)
- c. A bond must be posted to guarantee satisfactory construction of the BMP. If off-site, all easements must be recorded prior to issuance of a Land Disturbance Permit. ***Note - This may be a separate bond or posted with the first subdivision requiring the facility. The developer may choose to break this amount out separately as with the sewer and water.***

2. Recordation:

- a. If recording a subdivision adjacent to an RPA, both the 100-year flood plain and the RPA must be shown on the record plat if the RPA is less than 20' outside of the 100-year flood plain. The minimum finished floor must be shown on each lot.
- b. The 100-year flood plain and the RPA must be tied down to each affected property line.
- c. If the RPA exceeds the 100-year flood plain by 20+ feet, only the RPA line needs to be shown on the record plat. Minimum finished floor (MMF) must be shown on each lot.
- d. An asterisk (*) must be placed on the tributary side of each lot with an RPA and the following note must be on the plat, "Resource Protection Area is to remain in its natural state".
- e. The deed book and page number of the recorded BMP maintenance agreement will be shown on the subdivision plat for BMP's located within the proposed subdivision limits, or must be recorded simultaneously with the subdivision plat.

F. BMP Certification: Prior to state acceptance of any roads in any subdivision section that require a BMP facility, the BMP must be certified by a licensed engineer that it has been constructed as per the approved plans.

G. Design criteria for BMP's:

1. Extended Detention

- a. 3:1 side slopes or flatter
- b. All points of concentrated inflow to BMP's must tie into the bottom control elevation of the basin and be conveyed through the basin to the principal spillway via an adequate channel.
- c. Adequate access must be provided to the facility for maintenance and access easements provided.
- d. Top of dam must be at least 8' wide with a 3:1 side slope.
- e. In shallow marshes:
 - 1) The detention volume is not inclusive of the shallow marsh.
 - 2) Types of wetland vegetation to be planted must be shown on the plans.
- f. Embankment of facility shall be a controlled fill.
- g. Perforations in the riser must be pre-cast (not field made).
- h. If the 10-year storm exceeds the capacity of the principal concrete spillway, the emergency spillway must be paved to a 10-year depth (see "k" for further compliance).
- i. Emergency spillway (exceeding 10-year design):
 - 1) In natural ground, grass linings permitted.
 - 2) In fill, paved to 100-year depth.
- j. Barrel and riser pipes are to be concrete.
- k. Barrel and riser pipes no smaller than 10".
- l. Entire BMP facility must be enclosed within an easement.
- m. Trash racks must be utilized on all barrel and riser designs.

2. Wet Pond - Experience has shown that concrete weirs are more esthetically pleasing, not subject to seeping, easier to maintain and less of a safety problem.
- a. Pond must be 3' in depth, 10' from shore, except where mitigation is required.
 - b. If normal pool is above original ground, the dam must have a impermeable core keyed into impermeable subsurface soils.
 - c. Adequate access must be provided for maintenance, and access easements provided.
 - d. A 25' separation shall be maintained between the riser and nearest embankment. For existing facilities, alternative means will be considered.
 - e. A sluice gate must be provided to lower the water level for maintenance.
 - f. Trash racks must be utilized on all barrel and riser designs.
 - g. If 10-year storm exceeds the capacity of the principal concrete spillway, the emergency spillway must be paved to a 10-year depth (see "h" for further compliance).
 - h. Emergency spillway (exceeding a 10-year design):
 - 1) In natural ground, grass linings permitted.
 - 2) In fill, paved to 100-year depth.
 - i. Top of dam must be 8' wide with a 2:1 side slope.
 - j. Barrel and riser pipes to be concrete.
 - k. Barrel and riser pipe no smaller than 15".
 - l. Entire BMP facility must be enclosed with an easement.

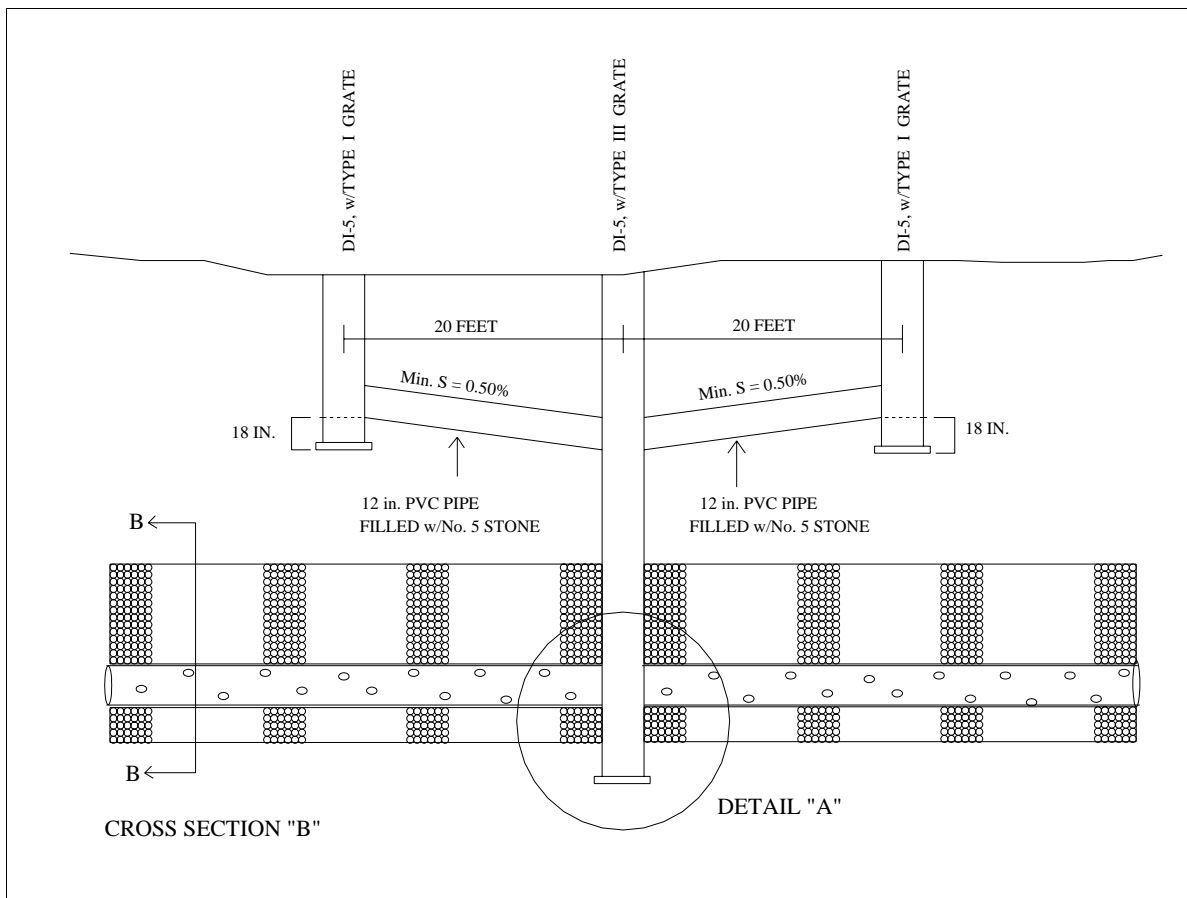


Figure 1
Three Drop Inlet Combination

4. Infiltration

- a. Infiltration may be used if the soils are suitable and certified by a qualified expert.
- b. A soils profile must accompany the plans.
- c. A three DI combination must be used in a sag condition (see figures 1 through 6).
- d. If constructed on grade the DI on down grade may be eliminated.

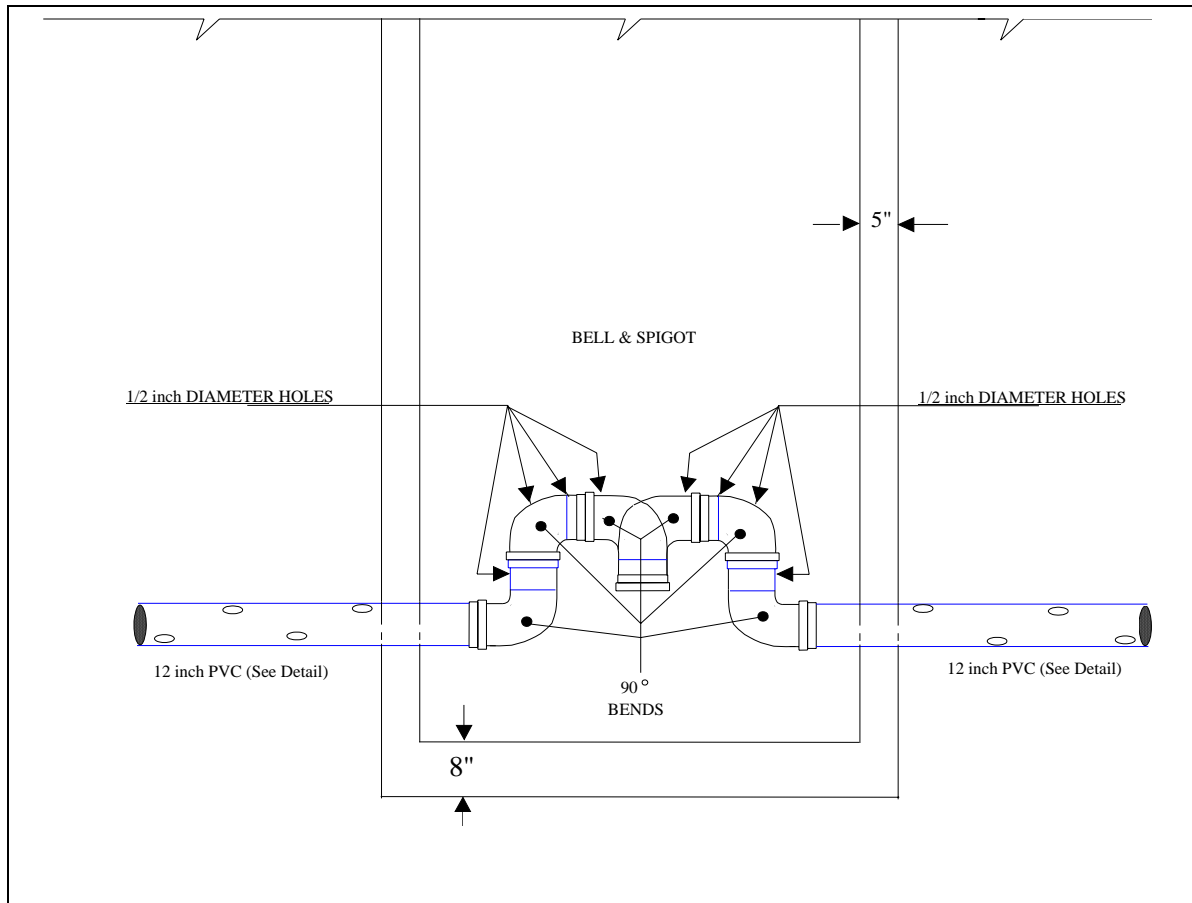


figure 2
Cross Section from Three Drop Inlet Combination

II. Sites (Commercial And Multi-Family)

A. BMP Types:

1. Extended detention
2. Wet Pond
3. Infiltration:
 - a. Infiltration devices can be used only when:
 - 1.) The field verified soils indicate they will support this type of BMP facility. This must be certified by a qualified expert.
 - 2.) When due to topographic and other extenuating circumstances beyond the developer's control that other BMP's are not feasible.

- b. The infiltration trenches, if allowed, must be designed and maintained for the entire site. *NOTE: Chesterfield County soils are not generally supportive of this type of design.*
- B. Site Construction Plans: Site plans which are submitted directly to the Planning Department, must be accompanied with the appropriate Chesapeake Bay information. (If CBPA has not been addressed, the Department of Environmental Engineering's initial review comment will be "no comments. CBPA has not been addressed".)
1. Site plans must show the RPA limits (to include the conservation area) when the development is affected by a "perennial stream".
 2. If wetlands have been field located and the RPA adjusted accordingly, they must be shown and proper documentation received.
 3. The applicant needs to submit the necessary calculations associated with the BMP design.
 4. All pertinent information as to grading of the basin, standpipes (concrete), must be shown in the appropriate place on the construction plans, to include a detail at a scale of 1"=20' or larger.
 5. *NOTE: If one chooses to opt out a portion of their site from the RMA and has submitted the certification by a qualified expert, those areas **must be delineated on the construction plans.***

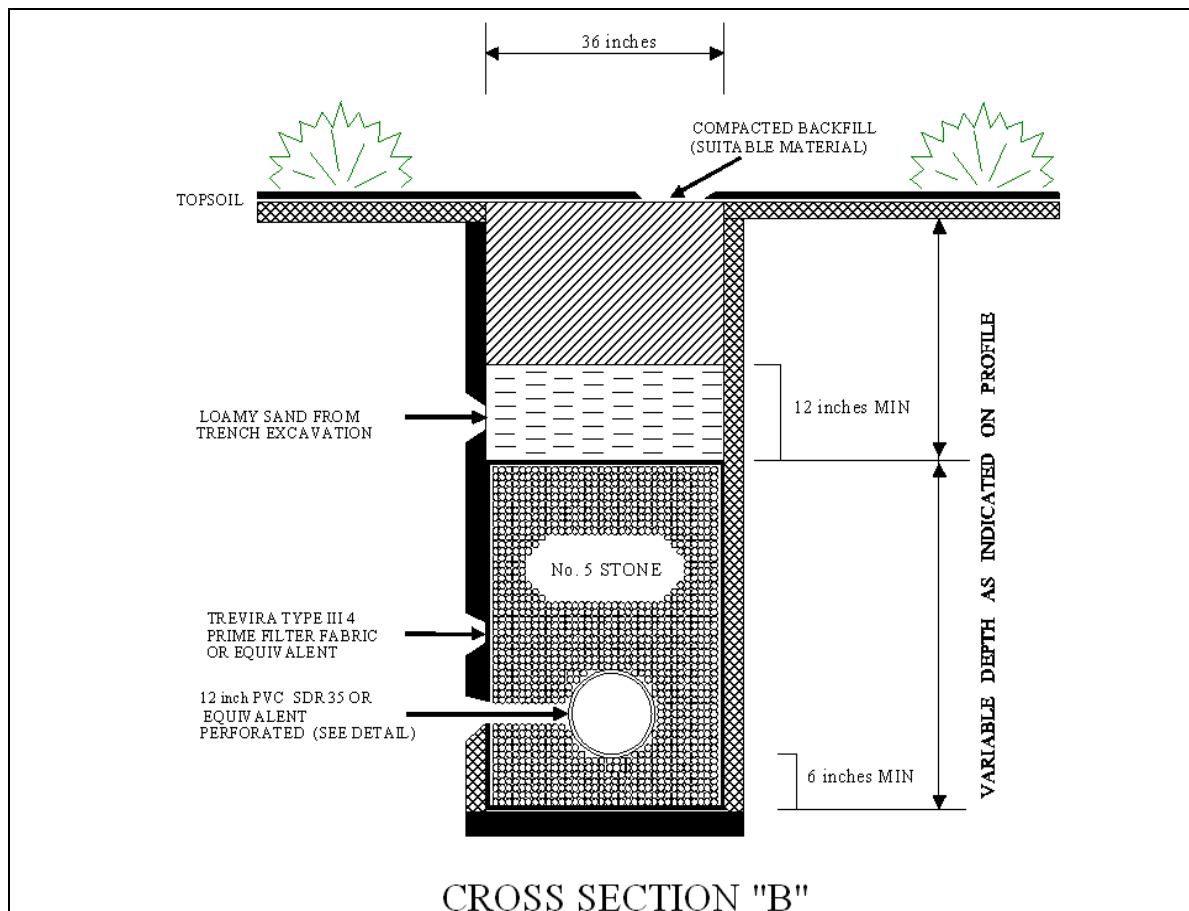


Figure 3
Detail from Three Drop Inlet Combination

C. Prerequisites for:

1. Land Disturbance Permit
 - a. Prior to the Environmental Engineering Department's issuance of the Land Disturbance Permit, a bond must be posted to guarantee satisfactory construction of the BMP and all easements recorded if off-site of the approved project site plan.
2. Certificate of Occupancy
 - a. Prior to obtaining the Environmental Engineering Department's approval of the Certificate of Occupancy, all necessary on-site easements must be recorded enclosing the BMP facility.
 - b. Prior to recommending approval of a C.O. for a commercial site, the appropriate BMP agreement must be approved by the County Attorney as to form; approved by Board of Supervisors; signed by County Administrator, recorded, and a recorded copy with the deed book and page number given to the Environmental Engineering Department (see Appendix A).
 - c. Prior to the Environmental Engineering Department recommending approval of a C.O. for commercial sites, the BMP facilities must be certified by a licensed engineer that they have been constructed as per the approved plans.

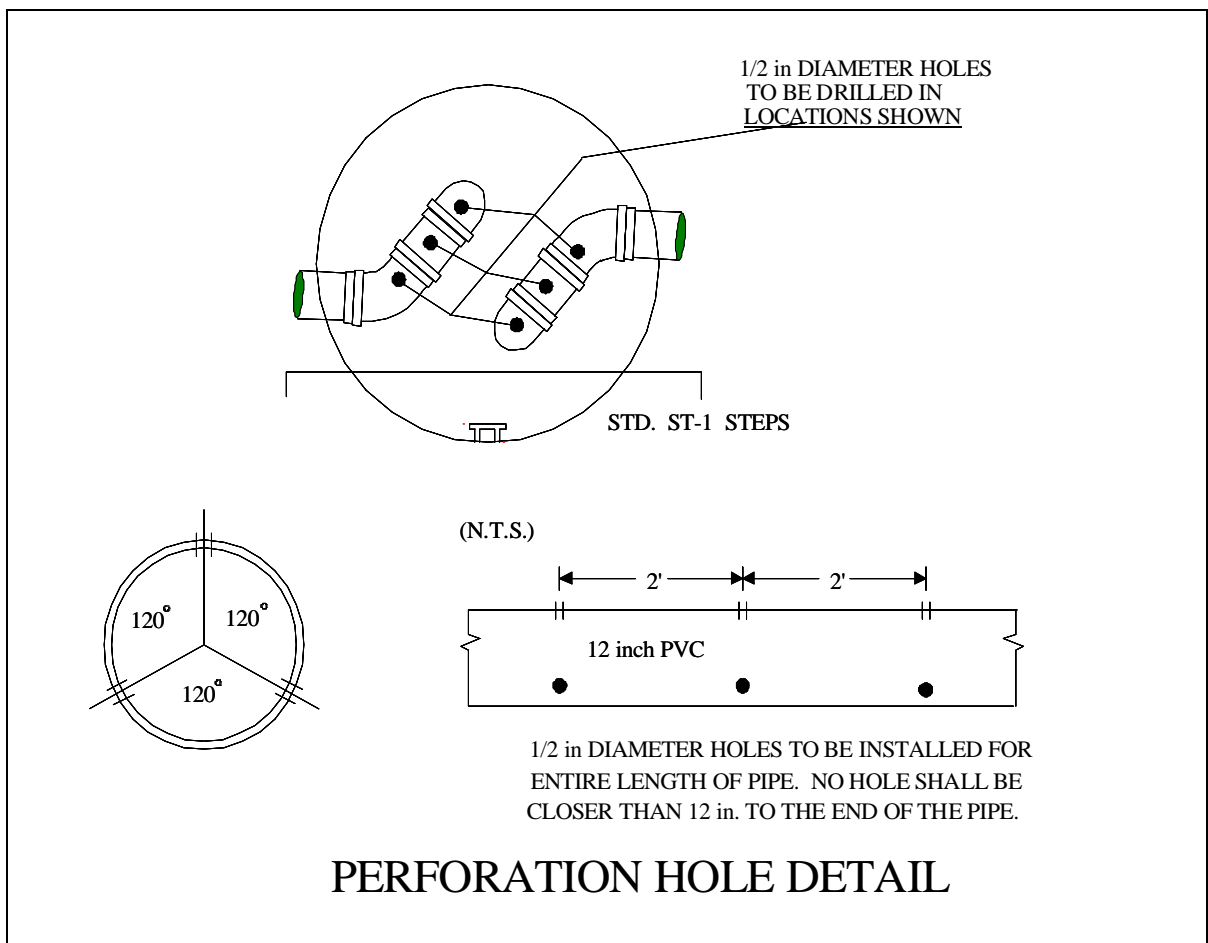


figure 4
Perforation Hole Placement for Bell & Spigot and 12 inch PVC Pipe

D. Design Criteria for BMP's

1. Extended Detention
 - a. 2:1 side slopes or flatter
 - b. If fenced, developer must provide gate and adequate access for maintenance, and access easements provided.
 - c. All points of concentrated inflow to BMP's must tie into the bottom control elevation of the basin and be conveyed through the basin to the principal spillway via an adequate channel.
 - d. Top of dam must be 8' wide with a 2:1 side slope.
 - e. If the 10-year storm exceeds the capacity of the principal concrete spillway, the emergency spillway must be paved to a 10-year depth (see "g" for further compliance).
 - f. Emergency spillway (exceeding a 10-year design):
 - 1.) In natural ground, grass linings permitted.
 - 2.) In fill, paved to 100-year depth.

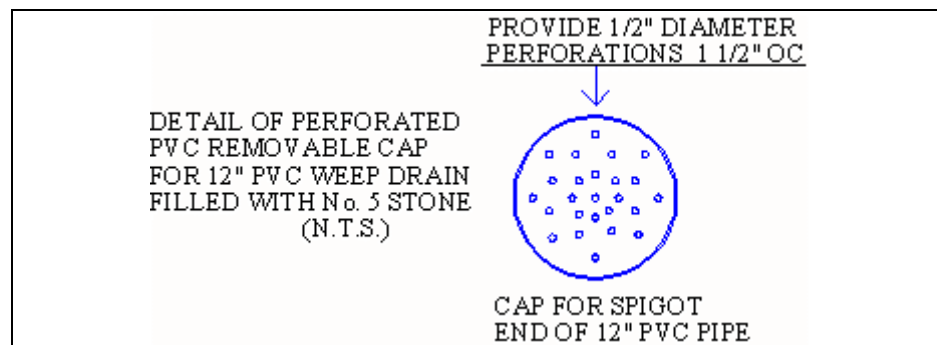


figure 5
End Cap for Spigot

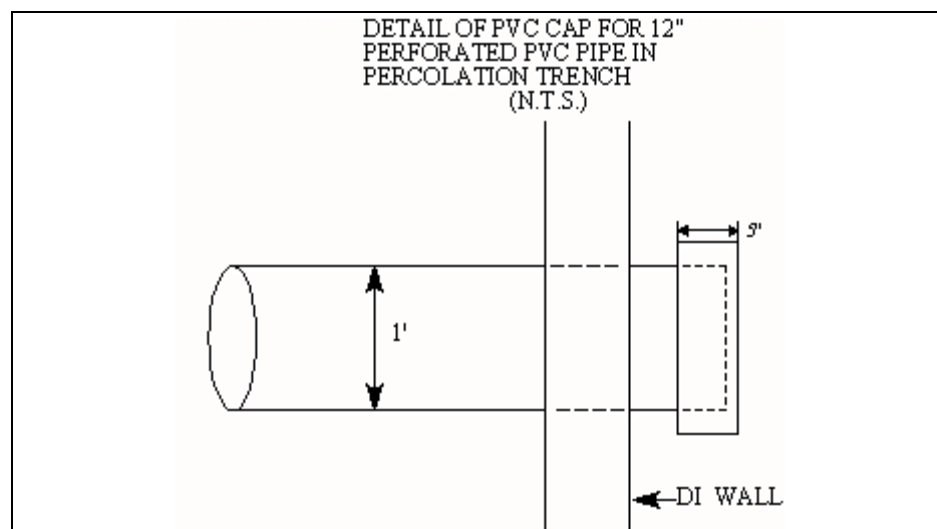


figure 6
End Cap Perforated PVC Pipe

g. In shallow marshes:

- 1.) The detention volume is not inclusive of the shallow marsh.
- 2.) Types of wetland vegetation to be planted must be shown on the plans.

- h. Embankment of facility shall be a controlled fill.
- i. Perforations in the riser must be pre-cast (not field made).
- j. Barrel and riser pipe are to be concrete.
- k. Barrel and riser pipe no smaller than 10".
- l. Trash racks must be utilized on all barrel and riser designs.
- m. Entire BMP facility must be enclosed within an easement.

2. Wet Pond - Experience has shown that concrete weirs are more esthetically pleasing, not subject to seeping, easier to maintain, and less of a safety problem.

- a. Pond must be 3' in depth, 10' from shore except where mitigation is required.
- b. If normal pool is above original ground, the dam must have an impermeable core keyed into impervious sub-surface soils.
- c. Adequate access must be provided for maintenance and access easements recorded.
- d. A 25' separation needs to be maintained between the riser and nearest embankment. For existing facilities, alternative means will be considered.
- e. A sluice gate must be provided to lower the water level for maintenance.
- f. Trash racks must be utilized on all barrel and riser designs.
- g. If 10-year exceeds the capacity of the principal concrete spillway, the emergency spillway must be paved to 10-year depth (see "h" for further compliance).
- h. Emergency spillway (exceeding a 10-year design):
 - 1.) In natural ground, grass linings permitted.
 - 2.) In fill, paved to 100-year depth.
- i. Top of facility must be 8' wide with a 2:1 side slope.
- j. Barrel and riser pipes are to be concrete.
- k. Barrel and riser pipe no smaller than 15".
- l. Entire BMP facility must be enclosed within an easement.

3. Infiltration

- a. Infiltration may be used if the soils are suitable and certified by a qualified expert.
- b. A soils profile must accompany the plans.
- c. A three DI combination may be used in a sag condition (see figures 1 through 6).
- d. If constructed on grade, the DI on down grade may be eliminated.
- e. Other alternatives will be considered such as area wide infiltration under parking lots. These will be considered on a case by case basis and must be accompanied by:
 - 1.) A manufacturers fabrication specification (if new product).
 - 2.) All pertinent manufacturers design criteria.
 - 3.) Calculations and any pertinent supporting documentation.

E. Redevelopment: In those areas of redevelopment, one must obtain a 10% reduction in the current phosphorus loading.

BMP AGREEMENT PROCEDURE

Step One:

Upon achievement of approval of the BMP design for the project, the Environmental Engineering Department will prepare a Board Agenda Item for the next scheduled meeting of the Board of Supervisors requesting the Board's authorization for the signature of the County Administrator on a BMP/Storm Water Maintenance Agreement in a form approved by the County Attorney.

Step Two:

Any time thereafter, the executed Agreement (owner signature authorized) is submitted to the Environmental Engineering Department and forwarded to the County Attorney's Office for format approval. The original Agreement is then returned to the Environmental Engineering Department and held until the authorization for the County Administrator's signature is achieved.

Step Three:

Environmental Engineering Department personnel obtain the County Administrator's signature on the agreement and forward it to the Right-of-Way Division of the Utilities Department.

Step Four:

The Right-of-Way Division contacts the developer to inform him of the recordation fees. The developer furnishes this amount to the Right-of-Way Division and the Agreement is then recorded along with the easement, if applicable, in the Clerk of the Courts Office by Right-of-Way Division personnel.

Step Five:

A copy of the recorded Agreement is provided to the Environmental Engineering Department for the file.

Step Six (subdivision only):

The deed book and page number of the Agreement is shown on the subdivision plat as a prerequisite to recordation.

**CHESTERFIELD COUNTY
ENVIRONMENTAL ENGINEERING DEPT.
CHESAPEAKE BAY PRESERVATION ACT**

CALCULATION PROCEDURES

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REFERENCES

The following references were used in the formulation of the Chesterfield County calculation procedures and are recognized source documents by leading experts in the field of non-point source pollution control.

1. **Controlling Urban Runoff: A practical Manual for Planning and Designing Urban BMP's**, Metropolitan Washington Council of Governments, 1987.

ORDER COPIES FROM: Metropolitan Information Center
Metropolitan Washington Council of Governments
1875 I Street, N.W., Suite 200
Washington, D.C. 20006
(202) 962-3200

COST: Yes

2. **BMP Handbook for the Occoquan Watershed**, Northern Virginia Planning District Commission, 1987.

ORDER COPIES FROM: Northern Virginia Planning District Commission
7630 Little River Turnpike
Suite 400
Annandale, Va 22003
(703) 642-0700

COST: Yes

3. **Local Assistance Manual**, Chesapeake Bay Local Assistance Department.

ORDER COPIES FROM: Chesapeake Bay Local Assistance Department
701 Eighth Street Office Building
Richmond, Va 23219
(804) 225-3440 or 1-800 CHESBAY

COST: Yes

COMPLIANCE STEPS

STEP ONE: Determine if the site contains any Resource Protection Areas (RPA)

Refer to the Chesterfield County Chesapeake Bay Preservation Areas Maps

RPA: Tidal wetlands, nontidal wetlands connected by surface flow and contiguous to tidal wetlands or tributary streams, tidal shores, vegetated conservation area not less than 100 feet in width located adjacent to and landward of the environmental features listed above, and along both sides of any tributary stream.

Delineate the limits of any RPA's

The 100 ft. conservation area component of the RPA may be reduced 50 ft. on parcels recorded prior to October 1, 1989. Parcels recorded on or after this date must provide a BMP which compensates for the lost pollutant removal capacity caused by a conservation area reduction. Refer to CBLAB information bulletin number 3 dated March 1991 for the buffer equivalency calculation procedures. In no case shall the conservation area be reduced to a width less than 50 ft.

STEP TWO: Determine if the site is classified as new development or redevelopment

Development: The construction, or substantial alteration of residential, commercial, industrial, institutional, recreational, transportation, or utility facilities or structures.

Redevelopment: The process of developing land that is or has been previously developed.

For development, the post-development non-point source phosphorous runoff load can not exceed the pre-development load (0.44 lbs/ac/yr residential and 0.50 lbs/ac/yr commercial) (refer to Table 3).

For redevelopment, the post-development non-point source phosphorous runoff load must be 90 percent or less of the pre-development load.

STEP THREE: Determine the pre-development phosphorous load (L_{pre})

For New Development: Chesterfield County adopted the default phosphorous loading factors of 0.44 lbs/ac/yr (residential) with an equivalent impervious cover of 15.5% and 0.50 lbs/ac/yr (commercial) with an equivalent impervious cover of 18.3%, which are based on average land cover conditions for Tidewater, Va. Therefore, the land use and the Plan for Chesterfield County determine which pre-development phosphorous loading factor is used.

The pre-development phosphorous loading can be calculated by multiplying the applicable loading factor (0.44 lbs/ac/yr or 0.50 lbs/ac/yr) by the total site area classified as CBPA area. Those areas which are allowed to opt out of the RMA due to the absence of RMA characteristics (100 yr. flood- plains, highly erodible soils, highly permeable soils and non-tidal wetlands not included in RPA's) are not used in calculating phosphorus loading. Thus:

$$L_{pre} = (0.44)(A_{site}) \quad \text{OR} \quad L_{pre} = (0.50)(A_{site})$$

For Redevelopment: Pre-development loads for redevelopment are not based on average land cover conditions. So the pre-development default phosphorous loads cannot be used. Therefore, pre-redevelopment percent impervious cover must be computed and the corresponding phosphorous loading factor (F_{pre}) extracted from table 1A.

$$L_{pre} = (F_{pre})(A_{site})$$

STEP FOUR: Determine the post-development phosphorous loading factor (L_{post})

Just as with step three, the designer needs to know the post-development impervious cover (or equivalent, see table 2).

For new development and redevelopment, extract the phosphorous loading factor from the table 1 or 1A which corresponds to the post development percent impervious cover.

As in step three those areas which are allowed to opt out of the RMA are not used in determining post-developed phosphorus loading.

$$L_{post} = (F_{post})(A_{site}) \quad \textbf{STEP FIVE: Determine the removal requirements (RR) and \%RR}$$

Remember from step two, the performance standards are different.

For Development:

$$RR = L_{post} - L_{pre}$$

For Redevelopment:

$$RR = L_{post} - [(0.9)(L_{pre})]$$

If the RR is less than or equal to zero, no BMP's are necessary and the applicant need only submit documentation to support such findings.
And:

$$\%RR = \left(\frac{RR}{L_{post}} \right) (100)$$

If removal efficiencies are required, continue on with STEP Six.

STEP SIX: Identify BMP option for the site

Best management practices (BMP's) are structural or non-structural devices or practices that prevent or reduce the amount of phosphorous generated by non-point sources to a level compatible with water quality goals.

The use of certain BMP's may be limited on some sites by soils, topography, area and other physical characteristics. Most BMP's can only be applied under restricted site conditions. Improperly sited, a BMP may even contribute pollutants, e.g. an eroding pond embankment sends sediment into the receiving stream.

BMP's and their associated phosphorous removal efficiencies are shown in Table 4.

STEP SEVEN: Determine if feasible BMP options can meet the phosphorous removal.

If runoff from the entire site passes through the BMP the applicant need only select a BMP with an efficiency rating equal to or greater than the efficiency required (%RR) determined in Step Five. If, as is usually the case, only portions of the site are covered by BMP's, the phosphorous load to each BMP must be calculated and the load removed by each facility determined.

Phosphorous reduction credits for serving off-site areas which drain through BMP's on the subject site are allowed. However, while applicants might claim phosphorous reduction credits for serving off-site areas, applicants may not claim credit for one or more off-site BMP's serving their property (even if, in fact, they do). Neither the Act nor the Regulations allow for such an off-set program.

When credit is taken for serving offsite areas, the phosphorous generated by the offsite areas is based upon the existing percent impervious area. Table 1A should be used to determine F_{exist} for offsite areas since existing impervious areas greater than or equal to 20% generate a higher flow-weighted mean concentration of pollutant (1.08 mg/l)

Although non-CBPA areas (areas which opted out of the RMA) are not used in determining phosphorous removal requirement, they may be used when calculating phosphorous loading removed. Onsite areas are analyzed based upon proposed percent impervious cover.

If no combination of BMP's can meet the required standard, the applicant must consider a different site design or arranging BMP's in series. BMP's in a series configuration provide a greater pollutant removal capability since runoff is treated multiple times. Efficiencies for BMP's in series are not summated rather, the second BMP removes that amount of phosphorous corresponding to its efficiency that was not captured by the first facility. For example, a BMP with 50% removal efficiency arranged in series after another 50% efficiency BMP would remove 50% of the phosphorous not captured by the first facility or the total removal efficiency of this system would be 75%. Increasing the proportion of site area covered with vegetation is one of the best ways of lowering the required removal efficiencies. A different site layout may make a more appropriate BMP possible; for example, placing structures on "tight" soils may leave more permeable soil for infiltration areas.

STEP EIGHT: Design BMP(s)

The optimal BMP design is one in which all site runoff passes through the facility. Realizing this is not a possibility for most situations, BMP's should be strategically located on the site to intercept as much flow as can be reasonably expected. Since, in most cases, not all site runoff may be treated due to certain field restrictions, it is possible to over compensate in one area while other areas remain untreated.

References 1 and 2 contain detailed information on BMP design. The primary focus of BMP design is to slow stormwater runoff to allow phosphorous, which attaches to sediment, time to settle to the bottom of the facility. A list of BMP designs recognized by the Chesapeake Bay Local Assistance Department is provided in Table 4.

As mentioned previously in Step Six, the uses of certain BMP's may be limited on some sites by soils, topography, area and other physical considerations. For example, Wet Ponds should not be used on sites with highly permeable soils ("A" or "B" hydrologic groupings), extended detention facilities should not be located in a continuously flowing stream, and infiltration facilities are not feasible on sites with "C" or "D" soils (infiltration rates less than 0.27 in/hr).

As mentioned previously in Step Seven, upstream offsite areas contributing to an onsite BMP are analyzed based on existing conditions. If the existing percent imperviousness is greater than 20% the higher flow weighted mean concentration of total phosphorus of 1.08 milligrams per liter may be used. Table 1A accomplishes this.

In acknowledgment of the rapid process of evolution in this field, other options are authorized provided an evaluation of the proposed BMP is submitted with the design which includes the following minimal information:

1. Justification for use (unique benefits)
2. Technical information with research data supporting pollutant removal efficiencies.
3. Maintenance Program and considerations.
4. Safety considerations.
5. Aesthetic considerations.
6. Potential effects on local population.
7. Pest control program, if applicable.

NOTE: STEPS ONE THROUGH SEVEN OCCUR AT THE TENTATIVE PHASE OF PLAN REVIEW AND STEP EIGHT IS SUBMITTED WITH THE CONSTRUCTION PLANS.

DERIVATION OF THE PHOSPHORUS LOADING FACTORS TABLE USING THE SIMPLE METHOD:

WHERE:

$$L = [(P_j)(P)(R_v/12)](C)(A)(2.72)$$

AND

- L = storm pollutant export (lbs/yr)
 - P = rainfall depth (inches) over the desired time interval
 - P_j = factor that corrects P for storms that produce no runoff (unitless)
 - R_v = runoff coefficient, which expresses the fraction of rainfall which is converted into runoff (unitless)
 - C = flow-weighted mean concentration of pollutant in urban runoff (mg/l)
 - A = area of development site (acres)
- 12 and 2.72 are unit conversion factors

WHERE

$$R_v = .05 + .009(I)$$

AND

- I = percent of site imperviousness (expressed as a whole number)

The Simple Method, which has been adopted by the Chesapeake Bay Local Assistance Department (CBLAB), is empirical in nature and utilizes the extensive database obtained in the Washington D.C. area National Urban Runoff Program (NURP) study and the national NURP database. It can be found in Appendix A of "Controlling Urban Runoff: A practical Manual for Planning and Designing Urban BMP's" published by the Metropolitan Washington Council of Governments (WASHCOG).

Since the pollutant Loading Factors are not dependent upon area, the unknown, A, is removed and the Storm Pollutant Export Equation (lbs/yr) becomes the Pollutant Loading Factor Equation (lbs/acre/yr).

THEREFORE:

$$F = [(P_j)(P)(R_v/12)](C)(2.72)$$

WHERE

- F = pollutant loading factor

Simplifying the equation using the following assumptions/ constants provided by CBLAB:

- P = 44 inches, average annual rainfall for Tidewater
- P_j = 0.9

C = 0.26 mg/1 for new suburban sites

OR

C = 1.08 mg/1 for redevelopment sites or new development when analyzing offsite areas for which credit is taken (when I is greater than or equal to 20)

The result is:

$$F = \{(44)(0.9)[(0.05+0.009(I))/12][(0.26) \text{ OR } (1.08)](2.72)$$

THEREFORE: for *new suburban sites* in Chesterfield County, $F = 0.116688 + [0.02100384(I)]$, and F

$= 0.484704 + [0.08724672(I)]$ for *redevelopment sites or new development when analyzing offsite areas for which credit is taken* in Chesterfield County (when I is greater than or equal to 20).

TABLE 1A - PHOSPHOROUS LOADING FACTORS
FOR NEW SUBURBAN SITES

I IMPERVIOUS COVER (%)	F PHOSPHORUS LOADING (lbs/acre/yr)	I IMPERVIOUS COVER (%)	F PHOSPHORUS LOADING (lbs/acre/yr)
0	0.12	26	0.66
1	0.14	27	0.68
2	0.16	28	0.70
3	0.18	29	0.73
4	0.20	30	0.75
5	0.22	31	0.77
6	0.24	32	0.79
7	0.26	33	0.81
8	0.28	34	0.83
9	0.31	35	0.85
10	0.33	36	0.87
11	0.35	37	0.89
12	0.37	38	0.91
13	0.39	39	0.94
14	0.41	40	0.96
15	0.43	41	0.98
16	0.45	42	1.00
17	0.47	43	1.02
18	0.49	44	1.04
19	0.52	45	1.06
20	0.54	46	1.08
21	0.56	47	1.10
22	0.58	48	1.12
23	0.60	49	1.15
24	0.62	50	1.17
25	0.64	51	1.19

**TABLE 1B - PHOSPHOROUS LOADING FACTORS FOR
NEW SUBURBAN SITES**

I IMPERVIOUS COVER (%)	F PHOSPHORUS LOADING (lbs/acre/yr)	I IMPERVIOUS COVER (%)	F PHOSPHORUS LOADING (lbs/acre/yr)
52	1.21	78	1.75
53	1.23	79	1.78
54	1.25	80	1.80
55	1.27	81	1.82
56	1.29	82	1.84
57	1.31	83	1.86
58	1.33	84	1.88
59	1.36	85	1.90
60	1.38	86	1.92
61	1.40	87	1.94
62	1.42	88	1.97
63	1.44	89	1.99
64	1.46	90	2.01
65	1.48	91	2.03
66	1.50	92	2.05
67	1.52	93	2.07
68	1.54	94	2.09
69	1.57	95	2.11
70	1.59	96	2.13
71	1.61	97	2.15
72	1.63	98	2.18
73	1.65	99	2.20
74	1.67	100	2.22
75	1.69		
76	1.71		
77	1.73		

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WAS

**“TABLE 1C - PHOSPHOROUS LOADING FACTORS FOR
REDEVELOPMENT SITES & OFFSITE AREAS
WHERE CREDIT IS TAKEN”**

WHICH IS NO LONGER APPLICABLE

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WAS

**“TABLE 1D - PHOSPHOROUS LOADING FACTORS FOR
REDEVELOPMENT SITES & OFFSITE AREAS
WHERE CREDIT IS TAKEN”**

WHICH IS NO LONGER APPLICABLE

TABLE 2
MINIMUM ALLOWABLE
PERCENT IMPERVIOUS COVER FOR VARIOUS DEVELOPMENT DENSITIES

<u>LAND USES</u>	<u>IMPERVIOUS COVER (%)</u>
5.00 Acre Residential Lots	5
2.00 Acre Residential Lots	10
1.00 Acre Residential Lots	15
0.90 Acre Residential Lots	16
0.80 Acre Residential Lots	17
0.70 Acre Residential Lots	18
0.60 Acre Residential Lots	19
0.50 Acre Residential Lots	20
0.33 Acre Residential Lots	25
0.25 Acre Residential Lots	30
Townhouses	35-40
Garden Apartments	50-55
Light Commercial/Industrial	65-75
Heavy Commercial/Industrial	85-90
Asphalt/Pavement/Compacted Gravel	100

TABLE 3
PRE-DEVELOPMENT DEFAULTS

<u>LOCATION</u>	<u>LAND USE</u>	<u>F_{pre} (lbs/ac/yr)</u>	<u>I(%)</u>	<u>MINIMUM LOT SIZE</u>
Chesterfield County	A	0.50	18.3	N/A
Chesterfield County	B	0.44	15.5	1.00 acre

Land Use A: Non-residential uses and residential uses at a density greater than 4.0 units per acre located in areas identified for such uses in The Plan for Chesterfield.

Land Use B: All uses other than LAND USE A.

- NOTES: 1. In no case shall the post-developed phosphorous loading factor (F_{post}) or equivalent percent impervious cover (I) be less than the pre-developed phosphorous loading factor (F_{pre}) or equivalent percent impervious cover (I).
2. Default imperviousness is used for determining the post-development phosphorus loading which must be captured to meet the criteria of no net increase, but in the actual BMP design process non-impervious areas contribute only that amount of phosphorous corresponding to 0% impervious cover.

TABLE 4
BMP EFFICIENCIES

<u>BMP/DESIGN</u>	<u>PHOSPHORUS REMOVAL EFFICIENCY</u>
EXTENDED DETENTION POND	
Design 1	20%
Design 2	30%
Design 3	50%
WET POND	
Design 4	35%
Design 5	40%
Design 6	50%
Design 7	65%
INFILTRATION	
Design 8	50%
Design 9	65%
Design 10	70%

- Design 1: Volume = V_r , detained for 6-12 hours
Design 2: Volume = $(2)(V_r)$, detained for 24 hours
Design 3: Same as design 2, but with a shallow marsh in the bottom stage.
Design 4: Permanent pool volume = V_r
Design 5: Permanent pool volume = $(2.5)(V_r)$
Design 6: Permanent pool volume = $(4)(V_r)$
Design 7: Permanent pool volume = $(10)(V_r)$
Design 8: Facility exfiltrates volume = V_r
Design 9: Facility exfiltrates volume = $(2)(V_r)$
Design 10: Facility exfiltrates volume = $(7)(V_r)$

AND

$$V_r = (D)[0.05 + 0.009(I)](A)(3630)$$

WHERE

- D = 0.5 inches of rainfall
I = percent of impervious cover in the contributing onsite watershed (whole #), include offsite areas for which credit is taken
A = area of the contributing onsite watershed (acres), including offsite areas for which credit is taken

WORKSHEET A **NEW DEVELOPMENT**

STEP 1: DETERMINE PRE-DEVELOPED PHOSPHOROUS LOADING

$$L_{pre} = (F_{pre})(A_{site})$$

WHERE:

L_{pre} = Pre-developed phosphorous load (lbs/yr)
 F_{pre} = Pre-developed phosphorous load (lbs/ac/yr) factor (Table 3)
 A_{site} = Area of RMA/RPA within the site (acres)

$$L_{pre} = (\quad)(\quad) = \quad \text{lbs/year}$$

STEP 2: DETERMINE ONSITE POST-DEVELOPED PHOSPHOROUS LOADING

$$L_{post} = (A)(F_{post})$$

WHERE:

A = RMA/RPA of each subarea within site (acres)
 F_{post} = Post-development phosphorous loading factor (Table 1) (lbs/ac/yr)
 I = Percent impervious area in each subarea

$A_{(ac)}$	I%	F_{post}	L_{post}
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
Total			_____
			=====

STEP 3: COMPUTE PHOSPHOROUS REMOVAL REQUIREMENT (RR)

L_{pre} = Pre-developed phosphorous load from STEP 1.
 L_{post} = Post-developed phosphorous load from total in STEP 2

$$RR = L_{post} - L_{pre}$$

$$RR = (\quad) - (\quad) = \quad \text{lbs/yr}$$

Note: Buffer reduction should be substantiated by additional phosphorous

removal computations.

STEP 4: COMPUTE PHOSPHOROUS LOADING FOR ONSITE/OFFSITE DRAINAGE AREAS

The phosphorous loading factor (F_{post}) for onsite areas is based upon the post developed percent impervious cover even when those areas are opted out of the RMA (use Table 1).

$$L_{\text{post}} = (A)(F_{\text{post}})$$

$A_{(\text{ac})}$	I%	F_{post}	L_{post}
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

The phosphorous loading factor (F_{exist}) for offsite areas is based upon the existing percent impervious cover (use Table 1A)

$$L_{\text{exist}} = (A)(F_{\text{exist}})$$

$A_{(\text{ac})}$	I%	F_{exist}	L_{exist}
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

STEP 5: SELECT BMP (from Table 4) FOR EACH DRAINAGE AREA WHICH IS SERVED BY A BMP AND CALCULATE LOAD REMOVED, L_r

Onsite (from STEP 4)			
L_{post}	BMP EFF (%)	DESIGN	L_{rp}
_____	_____	_____	_____

WHERE:

Total _____

$$L_{\text{rp}} = (L_{\text{post}}) \left(\frac{\text{BMPEFF}}{100} \right)$$

Offsite (from STEP 4)

L_{exist}	BMP EFF (%)	DESIGN	L_{re}
_____	_____	_____	_____
_____	_____	Total	_____
			=====

WHERE:

$$L_{re} = (L_{exist}) \left(\frac{BMP\ EFF}{100} \right)$$

If total L_r (summation of L_{rp} from onsite and L_{re} from offsite areas) is greater than or equal to RR, selected BMP(s) are adequate.

$$L_r = (L_{rp}) + (L_{re})$$

$$L_r = (\quad) + (\quad) = \quad \text{lbs/yr}$$

If an existing BMP is utilized, an "as built" design must accompany this worksheet with justification that the design meets acceptable BMP design standards.

WORKSHEET B REDEVELOPMENT

STEP 1: COMPILE BASIN SPECIFIC PRE-REDEVELOPMENT DATA

BASIN	A _(ac)	I _{a(ac)}	I(%)	F _{pre} (lbs/ac/tr)	L _{pre} (lbs/yr)
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
				Total	_____
					=====

WHERE:

- A = Area of each basin
- I_a = Impervious area in each basin (e.g. roofs, buildings, streets, parking areas, concrete, asphalt, compacted gravel)
- I = Percent impervious area in each basin (I_a/A * 100) (see Table 2 for minimum allowable)
- F_{pre} = Pre-redevelopment phosphorous loading factor from Table 1A.

$$L_{pre} = (A)(F_{pre})$$

STEP 2: COMPILE BASIN SPECIFIC POST-REDEVELOPMENT DATA

BASIN	A _(ac)	I _{a(ac)}	I(%)	F _{post} (lbs/ac/tr)	L _{post} (lbs/yr)
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
				Total	_____
					=====

WHERE:

- F_{post} = Post-redevelopment phosphorous loading factor from Table 1A.

$$L_{post} = (A)(F_{post})$$

STEP 3: COMPUTE PHOSPHOROUS REMOVAL REQUIREMENT (RR)

$$RR = L_{post}(\text{total}) - [(0.9)(L_{pre}(\text{total}))]$$

STEP 4: SELECT BMP (from Table 4) FOR EACH BASIN AND CALCULATE THE LOAD REMOVED, L_r.

L _{post}	BMP EFF (%)	DESIGN	L _r
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
		Total	=====

$$L_r = (L_{post}) \left(\frac{\text{BMP EFF}}{100} \right)$$

If total L_r is greater than or equal to RR, selected BMP(s) are adequate.

If an existing BMP is utilized, an "as built" design must accompany this worksheet with justification that the design meets acceptable BMP design standards.

EXAMPLES

1. **NEW DEVELOPMENT**

8 acre tract of 0.33 acre single family residential lots with a corresponding 25% impervious cover (Table 2). 6 acres drain to a BMP. The runoff from the remaining 2 acres does not pass through a BMP.

2. **NEW DEVELOPMENT WITH OFFSITE CREDITS**

100 acre tract consisting of 50 acres of 0.25 acre single family residential lots (30% impervious), 25 acres of townhouses (37% impervious), 21 acres of apartments (53% impervious), and 4 acres of park (10% impervious). There are three possible BMP locations. The townhouse and apartment parcels drain to one BMP. 37 acres of the 0.25 acre lots drain to a second BMP. The final BMP serves 80 acres of offsite area which is undeveloped and has no impervious cover.

3. **NEW DEVELOPMENT UTILIZING BMP'S IN SERIES**

20 acre heavy commercial site (85% impervious). The entire site drains to one location.

4. **NEW DEVELOPMENT WITH AREAS OPTED OUT OF THE RMA**

50 acre light commercial site (65% impervious). 10 acres qualifies to opt out of the RMA. 23 acres, including 6 acres of opted out areas, drain to one location. 10 acres, including the remaining 4 acres of opted out area, drain to a second location. 17 acres of the site does not pass through a BMP. A third BMP serves 10 acres of offsite area with a 60% impervious cover (existing condition).

SOLUTIONS

**EXAMPLE 1
WORKSHEET A
NEW DEVELOPMENT**

STEP 1: DETERMINE PRE-DEVELOPED PHOSPHOROUS LOADING

$$L_{pre} = (F_{pre})(A_{site})$$

WHERE:

- L_{pre} = Pre-developed phosphorous load (lbs/yr)
 F_{pre} = Pre-developed phosphorous load (lbs/ac/yr) factor (Table 3)
 A_{site} = Area of RMA/RPA within the site (acres)

$$L_{pre} = (0.44)(8) = 3.52 \text{ lbs/yr}$$

STEP 2: DETERMINE ONSITE POST-DEVELOPED PHOSPHOROUS LOADING

$$L_{post} = (A)(F_{post})$$

WHERE:

- A = RMA/RPA of each subarea within site (acres)
 F_{post} = Post-development phosphorous loading factor (Table 1A) (lbs/ac/yr)
 I = Percent impervious area in each subarea

$A_{(ac)}$	$I\%$	F_{post}	L_{post}
8	25	0.64	5.12
Total			5.12

STEP 3: COMPUTE PHOSPHOROUS REMOVAL REQUIREMENT (RR)

- L_{pre} = Pre-developed phosphorous load from STEP 1.
 L_{post} = Post-developed phosphorous load from total in STEP 2

$$RR = (L_{post}) - (L_{pre})$$

$$RR = (5.12) - (3.52) = 1.60 \text{ lbs/yr}$$

Note: Buffer reduction should be substantiated by additional phosphorous removal computations.

STEP 4: COMPUTE PHOSPHOROUS LOADING FOR ONSITE/OFFSITE DRAINAGE AREAS

The phosphorous loading factor (F_{post}) for onsite areas is based upon the post developed percent impervious cover even when those areas are opted out of the RMA (use Table 1A).

$A_{(\text{ac})}$	I%	F_{post}	L_{post}
6	25	0.64	3.84
_____	_____	_____	_____
_____	_____	_____	_____

The phosphorous loading factor (F_{exist}) for offsite areas is based upon the existing percent impervious cover (use Table 1C or 1D)

$$L_{\text{exist}} = (A)(F_{\text{exist}})$$

$A_{(\text{ac})}$	I%	F_{exist}	L_{exist}
_____	_____	_____	_____
_____	_____	_____	_____

STEP 5: SELECT BMP (from Table 4) FOR EACH DRAINAGE AREA WHICH IS SERVED BY A BMP AND CALCULATE LOAD REMOVED, L_r

Onsite (from STEP 4)

L_{post}	BMP EFF (%)	DESIGN	L_{rp}
3.84	50	6	1.92
_____	_____	_____	_____
_____	_____	Total	1.92

WHERE:

$$L_{\text{rp}} = (L_{\text{post}}) \left(\frac{\text{BMPEFF}}{100} \right)$$

Offsite (from STEP 4)

L_{exist}	BMP EFF (%)	DESIGN	L_{re}
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	Total	_____

WHERE:

$$L_{re} = (L_{dst}) \left(\frac{BMP\ EFF}{100} \right)$$

If total L_r (summation of L_{rp} from onsite and L_{re} from offsite areas) is greater than or equal to RR , selected BMP(s) are adequate.

$$L_r = (L_{rp}) + (L_{re})$$

$$L_r = (1.92) + (0) = 1.92 \text{ lbs/yr} > 1.60 \text{ } \textbf{OK!}$$

If an existing BMP is utilized, an "as built" design must accompany this worksheet with justification that the design meets acceptable BMP design standards.

**EXAMPLE 2
WORKSHEET A
NEW DEVELOPMENT**

STEP 1: DETERMINE PRE-DEVELOPED PHOSPHOROUS LOADING

$$L_{pre} = (F_{pre})(A_{site})$$

WHERE:

L_{pre} = Pre-developed phosphorous load (lbs/yr)
 F_{pre} = Pre-developed phosphorous load (lbs/ac/yr) factor (Table 3)
 A_{site} = Area of RMA/RPA within the site (acres)

$$L_{pre} = (0.44)(100) = 44 \text{ lbs/yr}$$

STEP 2: DETERMINE ONSITE POST-DEVELOPED PHOSPHOROUS LOADING

$$L_{post} = (A)(F_{post})$$

WHERE:

A = RMA/RPA of each subarea within site (acres)
 F_{post} = Post-development phosphorous loading factor (Tables 1A & 1B) (lbs/ac/yr)
 I = Percent impervious area in each subarea

$A_{(ac)}$	I%	F_{post}	L_{post}
50	30	0.75	37.50
25	37	0.89	22.25
21	53	1.23	25.83
4	10	0.33	1.32
Total			86.90

STEP 3: COMPUTE PHOSPHOROUS REMOVAL REQUIREMENT (RR)

L_{pre} = Pre-developed phosphorous load from STEP 1.
 L_{post} = Post-developed phosphorous load from total in STEP 2

$$RR = L_{post} - L_{pre}$$

$$RR = (86.90) - (44) = 42.90 \text{ lbs/yr}$$

Note: Buffer reduction should be substantiated by additional phosphorous removal computations.

STEP 4: COMPUTE PHOSPHOROUS LOADING FOR ONSITE/OFFSITE DRAINAGE AREAS

The phosphorous loading factor (F_{post}) for onsite areas is based upon the post developed percent impervious cover even when those areas are opted out of the RMA (use Table 1A).

$$L_{\text{post}} = (A)(F_{\text{post}})$$

$A_{(\text{ac})}$	I%	F_{post}	L_{post}
46	44	1.04	47.84
37	30	0.75	27.75

The phosphorous loading factor (F_{exist}) for offsite areas is based upon the existing percent impervious cover (use Table 1A)

$$L_{\text{exist}} = (A)(F_{\text{exist}})$$

$A_{(\text{ac})}$	I%	F_{exist}	L_{exist}
80	0	0.12	9.60

STEP 5: SELECT BMP (from Table 4) FOR EACH DRAINAGE AREA WHICH IS SERVED BY A BMP AND CALCULATE LOAD REMOVED, L_r

Onsite (from STEP 4)

L_{post}	BMP EFF (%)	DESIGN	L_{rp}
47.84	65	7	31.10
27.75	30	2	8.33
		Total	39.43

WHERE:

$$L_{\text{rp}} = (L_{\text{post}}) \left(\frac{\text{BMPEFF}}{100} \right)$$

Offsite (from STEP 4)

L_{exist}	BMP EFF (%)	DESIGN	L_{re}
9.60	50	6	4.80
		Total	4.80

WHERE:

$$L_{re} = (L_{exist}) \left(\frac{BMP\ EFF}{100} \right)$$

If total L_r (summation of L_{rp} from onsite and L_{re} from offsite areas) is greater than or equal to RR, selected BMP(s) are adequate.

$$L_r = (L_{rp}) + (L_{re})$$

$$L_r = (39.43) + (4.80) = 44.23 \text{ lbs/yr} > 42.90 \text{ } \textbf{OK!}$$

If an existing BMP is utilized, an "as built" design must accompany this worksheet with justification that the design meets acceptable BMP design standards.

**EXAMPLE 3
WORKSHEET A
NEW DEVELOPMENT**

STEP 1: DETERMINE PRE-DEVELOPED PHOSPHOROUS LOADING

$$L_{pre} = (F_{pre})(A_{site})$$

WHERE:

L_{pre} = Pre-developed phosphorous load (lbs/yr)
 F_{pre} = Pre-developed phosphorous load (lbs/ac/yr) factor (Table 3)
 A_{site} = Area of RMA/RPA within the site (acres)

$$L_{pre} = (0.50)(20) = 10 \text{ lbs/yr}$$

STEP 2: DETERMINE ONSITE POST-DEVELOPED PHOSPHOROUS LOADING

$$L_{post} = (A)(F_{post})$$

WHERE:

A = RMA/RPA of each subarea within site (acres)
 F_{post} = Post-development phosphorous loading factor (Tables 1B) (lbs/ac/yr)
 I = Percent impervious area in each subarea

$A_{(ac)}$	I%	F_{post}	L_{post}
20	85	1.90	38
Total			38

STEP 3: COMPUTE PHOSPHOROUS REMOVAL REQUIREMENT (RR)

L_{pre} = Pre-developed phosphorous load from STEP 1.
 L_{post} = Post-developed phosphorous load from total in STEP 2

$$RR = L_{post} - L_{pre}$$

$$RR = (38) - (10) = 28 \text{ lbs/yr}$$

Note: Buffer reduction should be substantiated by additional phosphorous removal computations.

STEP 4: COMPUTE PHOSPHOROUS LOADING FOR ONSITE/OFFSITE DRAINAGE AREAS

The phosphorous loading factor (F_{post}) for onsite areas is based upon the post developed percent impervious cover even when those areas are opted out of the RMA (use Table 1B).

$$L_{\text{post}} = (A)(F_{\text{post}})$$

$A_{(\text{ac})}$	I%	F_{post}	L_{post}
20	85	1.90	38

The phosphorous loading factor (F_{exist}) for offsite areas is based upon the existing percent impervious cover (use Table 1A)

$$L_{\text{exist}} = (A)(F_{\text{exist}})$$

$A_{(\text{ac})}$	I%	F_{exist}	L_{exist}

STEP 5: SELECT BMP (from Table 4) FOR EACH DRAINAGE AREA WHICH IS SERVED BY A BMP AND CALCULATE LOAD REMOVED, L_r

Onsite (from STEP 4)

L_{post}	BMP EFF (%)	DESIGN	L_{tp}
38	50	6	19
38-19=19	50	6	9.5 (second BMP)
		Total	28.5

WHERE:

$$L_r = (L_{\text{post}}) \left(\frac{\text{BMPEFF}}{100} \right)$$

Offsite (from STEP 4)

L_{exist}	BMP EFF (%)	DESIGN	L_{re}
		Total	

WHERE:

$$L_{re} = (L_{exist}) \left(\frac{BMP\ EFF}{100} \right)$$

If total L_r (summation of L_{rp} from onsite and L_{re} from offsite areas) is greater than or equal to RR, selected BMP(s) are adequate.

$$L_r = (L_{rp}) + (L_{re})$$

$$L_r = (28.5) + (0) = 28.5 \text{ lbs/yr} > 28 \text{ } **OK!**$$

If an existing BMP is utilized, an "as built" design must accompany this worksheet with justification that the design meets acceptable BMP design standards.

**EXAMPLE 4
WORKSHEET A
NEW DEVELOPMENT**

STEP 1: DETERMINE PRE-DEVELOPED PHOSPHOROUS LOADING

$$L_{pre} = (F_{pre})(A_{site})$$

WHERE:

L_{pre} = Pre-developed phosphorous load (lbs/yr)
 F_{pre} = Pre-developed phosphorous load (lbs/ac/yr) factor (Table 3)
 A_{site} = Area of RMA/RPA within the site (acres)

$$L_{pre} = (0.50)(40) = 20 \text{ lbs/yr}$$

STEP 2: DETERMINE ONSITE POST-DEVELOPED PHOSPHOROUS LOADING

$$L_{post} = (A)(F_{post})$$

WHERE:

A = RMA/RPA of each subarea within site (acres)
 F_{post} = Post-development phosphorous loading factor (Tables 1B) (lbs/ac/yr)
 I = Percent impervious area in each subarea

$A_{(ac)}$	I%	F_{post}	L_{post}
40	65	1.48	59.20
Total			59.20

STEP 3: COMPUTE PHOSPHOROUS REMOVAL REQUIREMENT (RR)

L_{pre} = Pre-developed phosphorous load from STEP 1.
 L_{post} = Post-developed phosphorous load from total in STEP 2

$$RR = L_{post} - L_{pre}$$

$$RR = (59.20) - (20) = 39.20 \text{ lbs/yr}$$

Note: Buffer reduction should be substantiated by additional phosphorous removal computations.

STEP 4: COMPUTE PHOSPHOROUS LOADING FOR ONSITE/OFFSITE DRAINAGE AREAS

The phosphorous loading factor (F_{post}) for onsite areas is based upon the post developed percent impervious cover even when those areas are opted out of the RMA (use Table 1B).

$$L_{\text{post}} = (A)(F_{\text{post}})$$

$A_{(\text{ac})}$	I%	F_{post}	L_{post}
23	65	1.48	34.04
10	65	1.48	14.80

The phosphorous loading factor (F_{exist}) for offsite areas is based upon the existing percent impervious cover (use Table 1B)

$$L_{\text{exist}} = (A)(F_{\text{exist}})$$

$A_{(\text{ac})}$	I%	F_{exist}	L_{exist}
10	60	5.72	57.20

STEP 5: SELECT BMP (from Table 4) FOR EACH DRAINAGE AREA WHICH IS SERVED BY A BMP AND CALCULATE LOAD REMOVED, L_r

Onsite (from STEP 4)

L_{post}	BMP EFF (%)	DESIGN	L_{rp}
34.04	50	6	17.02
14.80	50	4	5.18
		Total	22.20

WHERE:

$$L_{\text{rp}} = (L_{\text{post}}) \left(\frac{\text{BMPEFF}}{100} \right)$$

Offsite (from STEP 4)

L_{exist}	BMP EFF (%)	DESIGN	L_{re}
57.20	30	2	17.16
		Total	17.16

WHERE:

$$L_{re} = (L_{exist}) \left(\frac{BMP\ EFF}{100} \right)$$

If total L_r (summation of L_{rp} from onsite and L_{re} from offsite areas) is greater than or equal to RR, selected BMP(s) are adequate.

$$L_r = (L_{rp}) + (L_{re})$$

$$L_r = (22.20) + (17.16) = 39.36 \text{ lbs/yr} > 39.20 \text{ *OK!*}$$

If an existing BMP is utilized, an "as built" design must accompany this worksheet with justification that the design meets acceptable BMP design standards.

EXTENDED DETENTION
BMP DESIGN 1

Volume of runoff detained 6-12 hours equal to V_r ; where V_r = volume of runoff generated by the mean storm over the contributing onsite watershed (offsite area included if credit is taken).

Volume:	V_d	=	V_r
	V_d	=	Volume of runoff detained
	V_r	=	$(0.5)(R_v)(A)(3630)$
	R_v	=	$0.05 + ((0.009)(I))$
	I	=	Percent impervious cover of the contributing onsite watershed (offsite area included if credit is taken) (expressed as a whole number)
	A	=	Area of contributing onsite watershed (acres) [offsite area included if credit is taken]
	3630	=	conversion factor (cu.ft./acre-in)
	V_r	=	$(0.5)[0.05 + ((0.009)(I))(A)(3630)]$
	V_d	=	V_r cu. ft.

Detention:

$$Q_{ave} = \left(\frac{V_d}{(T)(3600)} \right)$$

WHERE:

Q_{ave}	=	Average outflow rate for desired detention time (cfs)
T	=	detention time (hrs)
3600	=	conversion factor (sec/hr)

AND

A_p	=	total perforation area (sq.ft.)
-------	---	---------------------------------

AND

$$A_p = \left(\frac{Q_{ave}}{0.6\sqrt{(64.4)(H_{ave})}} \right)$$

WHERE:

H_{ave}	=	$(0.5)[(\text{max. head}) - (\text{radius of outflow pipe in feet})]$
-----------	---	---

AND

$$N = \left(\frac{A_p}{A_b} \right)$$

WHERE:

N = number of perforations
 A_h = area of each perforation in square feet

Perforation Diameter	A_h
0.50 inch	0.0014
0.75 inch	0.0031
1.00 inch	0.0055

The number of perforations, **N**, of diameter A_h , shall be evenly spaced up the half of the riser opposite the barrel. Perforations shall begin at the facility floor elevation and riser shall be covered with wire mesh or filter fabric and gravel cone (4"-6" E.C. stone).

CONSTRUCTION PLANS SHALL INCLUDE THE FINAL DETAILED BMP DESIGN

EXTENDED DETENTION **BMP DESIGN 2**

Volume of runoff detained 24 hours equal to $2 * V_r$; where V_r = volume of runoff generated by the mean storm over the contributing onsite watershed (offsite area included if credit is taken).

Volume:	V_d	=	$2(V_r)$
	V_d	=	Volume of runoff detained
	V_r	=	$(0.5)(R_v)(A)(3630)$
	R_v	=	$0.05 + ((0.009)(I))$
	I	=	Percent impervious cover of the contributing onsite watershed (offsite area included if credit is taken) (expressed as a whole number)
	A	=	Area of contributing onsite watershed (acres) [offsite area included if credit is taken]
	3630	=	conversion factor (cu.ft./acre-in)
	V_r	=	$(0.5)[0.05 + ((0.009)(I))(A)(3630)$
	V_d	=	$2(V_r)$ cu. ft.

Detention:

$$Q_{ave} = \left(\frac{V_d}{(24)(3600)} \right)$$

WHERE:

Q_{ave}	=	Average outflow rate for desired detention time (cfs)
T	=	detention time (hrs)
3600	=	conversion factor (sec/hr)

AND

A_p	=	total perforation area (sq.ft.)
-------	---	---------------------------------

AND

$$A_p = \left(\frac{Q_{ave}}{0.6 \sqrt{(64.4)(H_{ave})}} \right)$$

WHERE:

H_{ave}	=	$(0.5)[(\text{max. head}) - (\text{radius of outflow pipe in feet})]$
-----------	---	---

AND

$$N = \left(\frac{A_p}{A_b} \right)$$

WHERE:

N = number of perforations
 A_h = area of each perforation in square feet

Perforation Diameter	A_h
0.50 inch	0.0014
0.75 inch	0.0031
1.00 inch	0.0055

The number of perforations, **N**, of diameter A_h , shall be evenly spaced up the half of the riser opposite the barrel. Perforations shall begin at the facility floor elevation and riser shall be covered with wire mesh or filter fabric and gravel cone (4"-6" E.C. stone).

CONSTRUCTION PLANS SHALL INCLUDE THE FINAL DETAILED BMP DESIGN

EXTENDED DETENTION BMP DESIGN 3

Volume of runoff detained 24 hours equal to 2 times V_r with a shallow marsh in the bottom stage; where V_r = volume of runoff generated by the mean storm over the contributing onsite watershed (offsite area included if credit is taken).

Volume:	V_d	=	$2(V_r)$
	V_d	=	Volume of runoff detained
	V_r	=	$(0.5)(R_v)(A)(3630)$
	R_v	=	$0.05 + ((0.009)(I))$
	I	=	Percent impervious cover of the contributing onsite watershed (offsite area included if credit is taken) (expressed as a whole number)
	A	=	Area of contributing onsite watershed (acres) [offsite area included if credit is taken]
	3630	=	conversion factor (cu.ft./acre-in)
	V_r	=	$(0.5)[0.05 + ((0.009)(I))(A)(3630)]$
	V_d	=	$2(V_r)$ cu. ft.

Detention:

$$Q_{ave} = \left(\frac{V_d}{(T)(3600)} \right)$$

WHERE:

Q_{ave}	=	Average outflow rate for desired detention time (cfs)
T	=	detention time (hrs)
3600	=	conversion factor (sec/hr)

AND

A_p	=	total perforation area (sq.ft.)
-------	---	---------------------------------

AND

$$A_p = \left(\frac{Q_{ave}}{0.6\sqrt{(64.4)(H_{ave})}} \right)$$

WHERE:

H_{ave}	=	$(0.5)[(\text{max. head}) - (\text{radius of outflow pipe in feet})]$
-----------	---	---

AND

$$N = \left(\frac{A_P}{A_h} \right)$$

WHERE:

N = number of perforations
 A_h = area of each perforation in square feet

Perforation Diameter	A_h
0.50 inch	0.0014
0.75 inch	0.0031
1.00 inch	0.0055

The number of perforations, **N**, of diameter **A_h** , shall be evenly spaced up the half of the riser opposite the barrel. Perforations shall begin at the facility floor elevation and riser shall be covered with wire mesh or filter fabric and gravel cone (4"-6" E.C. stone).

Perforations will begin at an elevation 12 inches above the bottom of the BMP. A shallow marsh establishment plan shall accompany this design. Refer to references 1 and 2 for further guidance. Shallow marsh depth shall be 12 inches and the surface area equal to 2% of the contributing onsite watershed (offsite area included if credit is taken) or the volume is computed using the following equation:

$$V_{olb} = \left[(0.05) \left(\frac{R_v}{12} \right) \right] (A) (43560)$$

WHERE:

V_{olb} = Volume of shallow marsh (cu.ft.)
 R_v = $0.05 + [(0.009)(I)]$
I = percent impervious cover of the contributing onsite watershed (offsite area included if credit taken) (expressed as a whole number)
A = area of contributing onsite watershed (offsite area included if credit is taken) (acres)
43,560 = conversion factor from acre-ft. to cu.ft.

CONSTRUCTION PLANS SHALL INCLUDE THE FINAL DETAILED BMP DESIGN

WET POND
BMP DESIGN 4

Volume of permanent pool equal to V_r ; where V_r = volume of runoff generated by the mean storm over the contributing onsite watershed (offsite area included if credit is taken).

Volume:	V_p	=	V_r
	V_p	=	Volume of permanent pool
	V_r	=	$(0.5)(R_v)(A)(3630)$
	R_v	=	$0.05 + ((0.009)(I))$
	I	=	Percent impervious cover of the contributing onsite watershed (offsite area included if credit is taken) expressed as a whole number
	A	=	Area of contributing onsite watershed acres (offsite area included if credit is taken)
	3630	=	conversion factor (cu.ft./acre-in)
	V_r	=	$(0.5)[0.05 + ((0.009)(I))(A)(3630)]$
	V_p	=	V_r cu. ft.

Although Q_{in} may equal Q_{out} for this facility, any stormwater management concerns should be addressed. Storage volume for stormwater management purposes begins at the maximum elevation of the permanent pool.

CONSTRUCTION PLANS SHALL INCLUDE THE FINAL DETAILED BMP DESIGN

WET POND
BMP DESIGN 5

Volume of permanent pool equal to 2.5 times V_r ; where V_r = volume of runoff generated by the mean storm over the contributing onsite watershed (offsite area included if credit is taken).

Volume:

$$V_p = (2.5)(V_r)$$

V_p = Volume of permanent pool

$$V_r = (0.5)(R_v)(A)(3630)$$
$$R_v = 0.05 + ((0.009)(I))$$

I = Percent impervious cover of the contributing onsite watershed (offsite area included if credit is taken) (expressed as a whole number)

A = Area of contributing onsite watershed (acres) [offsite area included if credit is taken]

3630 = conversion factor (cu.ft./acre-in)

$$V_r = (0.5)[0.05 + ((0.009)(I))(A)(3630)$$
$$V_p = (2.5)(V_r) \text{ cu. ft.}$$

Although Q_{in} may equal Q_{out} for this facility, any stormwater management concerns should be addressed. Storage volume for stormwater management purposes begins at the maximum elevation of the permanent pool.

CONSTRUCTION PLANS SHALL INCLUDE THE FINAL DETAILED BMP DESIGN

WET POND
BMP DESIGN 6

Volume of permanent pool equal to 4 times V_r ; where V_r = volume of runoff generated by the mean storm over the contributing onsite watershed (offsite area included if credit is taken).

Volume:	V_p	=	$(4)(V_r)$
	V_p	=	Volume of permanent pool
	V_r	=	$(0.5)(R_v)(A)(3630)$
	R_v	=	$0.05 + ((0.009)(I))$
	I	=	Percent impervious cover of the contributing onsite watershed (offsite area included if credit is taken) (expressed as a whole number)
	A	=	Area of contributing onsite watershed (acres) [offsite area included if credit is taken]
	3630	=	conversion factor (cu.ft./acre-in)
	V_r	=	$(0.5)[0.05 + ((0.009)(I))(A)(3630)$
	V_p	=	$(4)(V_r)$ cu. ft.

Although Q_{in} may equal Q_{out} for this facility, any stormwater management concerns should be addressed. Storage volume for stormwater management purposes begins at the maximum elevation of the permanent pool.

CONSTRUCTION PLANS SHALL INCLUDE THE FINAL DETAILED BMP DESIGN

WET POND
BMP DESIGN 7

Volume of permanent pool equal to 10 times V_r ; where V_r = volume of runoff generated by the mean storm over the contributing onsite watershed (offsite area included if credit is taken).

Volume:

$$V_p = (10)(V_r)$$

V_p = Volume of permanent pool

$$V_r = (0.5)(R_v)(A)(3630)$$
$$R_v = 0.05 + ((0.009)(I))$$

I = Percent impervious cover of the contributing onsite watershed (offsite area included if credit is taken) (expressed as a whole number)

A = Area of contributing onsite watershed (acres) [offsite area included if credit is taken]

3630 = conversion factor (cu.ft./acre-in)

$$V_r = (0.5)[0.05 + ((0.009)(I))(A)(3630)$$
$$V_p = (10)(V_r) \text{ cu. ft.}$$

Although Q_{in} may equal Q_{out} for this facility, any stormwater management concerns should be addressed. Storage volume for stormwater management purposes begins at the maximum elevation of the permanent pool.

CONSTRUCTION PLANS SHALL INCLUDE THE FINAL DETAILED BMP DESIGN

INFILTRATION **BMP DESIGN 8**

Facility exfiltrates volume equal to V_r ; where V_r = volume; of runoff generated by the mean storm over the contributing onsite watershed. (offsite area included if credit is taken)

Minimum criteria:

- infiltration rate of soils greater than or equal to 0.27in/hr (typically A or B soils)
- bottom of stone reservoir 4 ft from bedrock and seasonally high water table
- facility located no less than 100 ft from wells
- facility located no less than 10 ft down gradient or 100 ft up gradient from foundations
- sides lined with filter fabric prior to filling with aggregate to prevent clogging
- drain time 48 to 72 hrs.
- slope of contributing drainage area less than or equal to 20%

Proof that the above minimum criteria has been met must be included with BMP design details.

Volume:	V_e	=	V_r
	V_e	=	Volume of runoff to exfiltrate
	V_r	=	$(0.5)(R_v)(A)(3630)$
	R_v	=	$0.05 + ((0.009)(I))$
	I	=	Percent impervious cover of the contributing onsite watershed (offsite area included if credit is taken) (expressed as a whole number)
	A	=	Area of contributing onsite watershed (acres) [offsite area included if credit is taken]
	3630	=	conversion factor (cu.ft./acre-in)
	V_r	=	$(0.5)[0.05 + ((0.009)(I))(A)(3630)$
	V_e	=	V_r cu. ft.

CONSTRUCTION PLANS SHALL INCLUDE THE FINAL DETAILED BMP DESIGN

INFILTRATION **BMP DESIGN 9**

Facility exfiltrates volume equal to 2 times V_r ; where V_r = volume of runoff generated by the mean storm over the contributing onsite watershed. (offsite area included if credit is taken)

Minimum criteria:

- infiltration rate of soils greater than or equal to 0.27in/hr (typically A or B soils)
- bottom of stone reservoir 4 ft from bedrock and seasonally high water table
- facility located no less than 100 ft from wells
- facility located no less than 10 ft down gradient or 100 ft up gradient from foundations
- sides lined with filter fabric prior to filling with aggregate to prevent clogging
- drain time 48 to 72 hrs.
- slope of contributing drainage area less than or equal to 20%

Proof that the above minimum criteria has been met must be included with BMP design details.

Volume:	V_e	=	$(2)(V_r)$
	V_e	=	Volume of runoff to exfiltrate
	V_r	=	$(0.5)(R_v)(A)(3630)$
	R_v	=	$0.05 + ((0.009)(I))$
	I	=	Percent impervious cover of the contributing onsite watershed (offsite area included if credit is taken) expressed as a whole number
	A	=	Area of contributing onsite watershed acres (offsite area included if credit is taken)
	3630	=	conversion factor (cu.ft./acre-in)
	V_r	=	$(0.5)[0.05 + ((0.009)(I))(A)(3630)$
	V_e	=	$(2)(V_r)$ cu. ft.

CONSTRUCTION PLANS SHALL INCLUDE THE FINAL DETAILED BMP DESIGN

INFILTRATION **BMP DESIGN 10**

Facility exfiltrates volume equal to 7 times V_r ; where V_r = volume of runoff generated by the mean storm over the contributing onsite watershed (offsite area included if credit is taken).

Minimum criteria:

- infiltration rate of soils greater than or equal to 0.27in/hr (typically A or B soils)
- bottom of stone reservoir 4 ft from bedrock and seasonally high water table
- facility located no less than 100 ft from wells
- facility located no less than 10 ft down gradient or 100 ft up gradient from foundations
- sides lined with filter fabric prior to filling with aggregate to prevent clogging
- drain time 48 to 72 hrs.
- slope of contributing drainage area less than or equal to 20%

Proof that the above minimum criteria has been met must be included with BMP design details.

Volume:	V_e	=	$(7)(V_r)$
	V_e	=	Volume of runoff to exfiltrate
	V_r	=	$(0.5)(R_v)(A)(3630)$
	R_v	=	$0.05 + ((0.009)(I))$
	I	=	Percent impervious cover of the contributing onsite watershed (offsite area included if credit is taken) expressed as a whole number
	A	=	Area of contributing onsite watershed acres (offsite area included if credit is taken)
	3630	=	conversion factor (cu.ft./acre-in)
	V_r	=	$(0.5)[0.05 + ((0.009)(I))(A)(3630)$
	V_e	=	$(7)(V_r)$ cu. ft.

CONSTRUCTION PLANS SHALL INCLUDE THE FINAL DETAILED BMP DESIGN

UPPER SWIFT CREEK WATERSHED

The Upper Swift Creek Watershed consists of all lands in the County located upstream of the Swift Creek Reservoir Dam. All development regulations will follow that of the Chesapeake Bay Protection Area Ordinance with the following additions:

1. Lead
 - a. The post-development total lead load for non residential uses at a density greater than 2.2 units per acre located in areas identified for such uses in the plan for Chesterfield County shall not exceed 0.19 pounds per acre per year.
 - b. The post-development total lead load for all other uses shall not exceed 0.03 pounds per acre per year.

By removing total phosphorous it has been determined through testing that an equal or greater level of removal for most other urban pollutants, to include lead, is simultaneously obtained. Therefore, the Department's approach will be that if you have achieved your removal rate for phosphorous, you will have automatically achieved the removal rate for the lead component.

2. No opting out will be allowed in the Upper Swift Creek Watershed, as no RPA or RMA are involved in the Upper Swift Creek Watershed Ordinance.

All other criteria, as applied to construction plans, redevelopment, final check plats, indemnification agreements, etc. will follow that of the Chesapeake Bay Preservation Areas (CBPA).

Please refer to the CBPA section of the manual.

In areas of multi-family and commercial, industrial, all runoff must pass through a BMP. In all other residential areas water quality compliance in the Upper Swift Creek watershed may be achieved through all appropriate means, to include reduced imperviousness (1 acre lots) and over compensation in outfalls.

MULTI-FAMILY DEVELOPMENT

Townhouse/Condominiums/Apartments.....	149
Duplexes and Quadraplexes.....	150
High Rise Apartments.....	150

MULTI-FAMILY DEVELOPMENT

Multi-family development, as viewed by Engineering, consists of the following:

- Townhouses
- Condominiums
- Apartments
- Duplexes and Quadraplexes
- High rise

Even though apartments are owned and maintained by the corporation or company, they will be handled as townhouses and condominiums which are individually owned since at any time they could be turned into condominiums.

I. Townhouse/Condominiums/Apartments - In general, townhouses, condominiums and apartments will conform to the following criteria.

- A. All normal design criteria per other sections of this manual must be adhered to.
- B. In conjunction with the above, the roof drainage lines must be shown as to what portion of the units drain to the front, rear and/or sides.
- C. When swales which are parallel to the units are necessary to drain water around the buildings, the following must be adhered to:

Back of Units:

1. Swales must be located totally on common property for townhouses, or no closer than 29' to a patio, whichever is further.
2. In apartments and condominiums the edge of the swales must be located at least 20' from the back edge of the units or patios.
3. If A. and B. above cannot be accomplished, then a small drainage system must be installed in combination with swales and a surface inlet located to the rear of each individual unit. This system must be at least 6" in diameter.
4. All swales will be 4:1 or flatter and have a minimum grade of 0.8%.
5. In condominiums, townhouses and apartments which utilize decks in the rear, gutters and downspouts must be used if the grade away from the unit exceeds 5%.

Front of Units:

1. All units should be designed to drain water perpendicular from the units towards the parking facility in the front. If this cannot take place and water must flow parallel to the building across the front of the units, the following must be accomplished.
 - a. The swales to the front of the units must be flatter than 5:1 with a minimum grade of 0.8%.
 - b. Access under the sidewalks must be provided for water to flow from one side of the sidewalk to the other.

- c. If the units break in the center and drain in two directions and gutters and downspouts are provided through to the curb flow line, then sidewalk drains will not be required.

In general, no large areas of concentrated flow from the rear of units that flow towards the front of the facility can utilize sheet flow ovetop of sidewalks.

- II. Duplexes and Quadraplexes** - Handled as normal single family residences provided no site plan approval was required.
- III. High Rise Apartments** - Will be handled as conventional site plans.

**BUILDING PERMITS/CERTIFICATES OF OCCUPANCY
BUILDING PERMIT APPLICATIONS**

Building Permits

Residential.....	153
Commercial.....	153

Certificates of Occupancy

Single Family.....	154
Commercial.....	154

Memorandum of Understanding between Building Inspections and Environmental Engineering regarding Residential Lot Drainage.....	155
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BUILDING PERMITS AND CERTIFICATES OF OCCUPANCY

- I. BUILDING PERMIT APPLICATIONS** - In any development, be it commercial or residential, there are certain requirements that must be met prior to the Department of Engineering signing off on building permit applications. No matter what the type of development, Engineering will not sign off on building permit Applications under the following circumstances:
- A. Residential**
1. General
 - a. Failure of subdivision to be recorded (by ordinance).
 - b. Failure of developer to maintain proper erosion control measures and a Notice of Violation has been issued (by ordinance).
 2. On subdivision plans that exhibit the following the engineer shall note No Building Permit (NBP) on individually affected lots:
 - a. Where filling needs to be done on lots due to topography that is outside of flood plains.
 - b. When drainage through lots must be rerouted via storm sewer, open channel, etc. in order to make the lots buildable.
 - c. On small lot subdivisions where drainage pits or silt basins are within 100' of any dwelling. (Note: This may not come to light until the building permit is applied for)
 - d. Where mine shafts or other soils information is required or pits to be filled in.
 - e. If drainage improvements have not been installed, then the inspector will only release one building permit until improvements have been installed.
 - f. No building permits will be designated on plans for those lots that have driveway culverts in proposed roadside ditch subdivision that are 24" or larger, and in those instances where off-site streams must be crossed in order to gain access to the building site.
 - g. Lots designated for stockpiling of material or debris.
 - h. Failure to provide appropriate sketch and/or failure to pay any appropriate program administration fee (see Erosion & Sediment Control).

Each individual building permit application will be field checked by the Department of Engineering and at this level of inspection, the inspectors may hold building permits if they deem a yard grading plan is necessary in order to show that the builder can provide swales around the house, intercept minor, but significant drainage, that is not picked up on the plans and any other drainage or stabilization related features.

B. Commercial

1. Failure to obtain a Land Disturbance Permit.
2. Failure to maintain erosion control devices.
3. Site plan approval has not been received by Engineering (note: if, in the opinion of the review engineer, the remaining items for site plan approval are cosmetic and/or minor, the review engineer may sign off on a footing permit only.
4. Building permit applications may not be approved by the inspector if site plans call for drainage improvements to be physically installed in order to reroute drainage around the proposed site.

II. CERTIFICATES OF OCCUPANCY

A. Single Family:

For that small portion of the building permits in which the inspector feels it is necessary to review the site prior to a full Certificate of Occupancy (C.O.), the Building Inspection Department will be so notified through the initial issuance of the building permit.

Upon notification by the builder, the Engineering Department inspector will visit the site to determine if the initial remarks made at the time of building permit application have been taken care of. If everything is in order, the inspector will sign off on the full C.O. If not, and the inspector determines it is not a safety or health hazard at that particular point in time, he may give the builder a 60 day temporary C.O. in order to allow him time to correct the deficiencies. Some temporary C.O.'s could be approved by Engineering when soil stabilization on the lot is critical and the time of year is not conducive for seeding.

If the driveway culvert is installed (30" or larger) or multiple lines of pipes and the headwalls have not been installed, the inspector will not issue a temporary C.O. .

A temporary C.O. can be issued prior to finishing or fine grading of lots when seeding or vegetation establishment is not a critical.

B. Commercial

Commercial sites must have the complete installation of all drainage systems and be totally stabilized to obtain a C.O. if the remaining work is not considered to be a health, safety and welfare problem to the workers or clients using the establishment. A bond must be posted for the work remaining to be performed to the appropriate county authority and there can be no major erosion problems on the site.

The Engineering inspector may sign off on a 60-day temporary C.O. .

MEMORANDUM OF UNDERSTANDING

between the Departments of Environmental Engineering and Building Inspection

Subject: **Residential Lot Drainage**

It is the intent of this memorandum of understanding that any and all areas of the lot disturbed during the construction of a dwelling shall be graded so as to prevent water accumulation and ponding.

Departmental responsibilities prior to issuance of the Certificate of Occupancy

Building Inspection: As part of the final inspection required prior to issuing a Certificate of Occupancy for a new, single family dwelling, the Building Inspector will assure that the grade within ten (10) feet of the foundation perimeter is properly sloped to achieve adequate drainage away from the foundation as required by the building code.

For portions of the lot more than ten feet from the foundation, when notified by the Department of Environmental Engineering that a drainage problem is unresolved, the Building Inspector will then take appropriate action to achieve compliance, which may include issuing a Notice of Violation.

Environmental Engineering: As part of the inspection process, the Environmental Engineering Inspector will work with the builder to achieve adequate drainage of the cleared and regraded portions of the lot.

In those instances where this process does not bring acceptable results, the Environmental Engineering Inspector will refer the situation to the Building Inspector for enforcement.

Departmental responsibilities after the issuance of the Certificate of Occupancy

Environmental Engineering: In instances when there is a valid concern about grading after the Certificate of Occupancy has been issued, the Environmental Engineering Inspector, after determining that the inadequate grading is the responsibility of the builder, will work with the builder to achieve adequate drainage.

In those instances where this process does not bring acceptable results, the Environmental Engineering Inspector will refer the situation to the Building Inspector for enforcement.

Building Inspection: When notified by Environmental Engineering that a drainage problem is unresolved, the Building Inspector will then take appropriate action to achieve compliance, which may include issuing a Notice of Violation.

On occasion, homeowners may have concerns about lot drainage and water problems that are not addressed by the Building Code or a County ordinance. In these cases, Environmental Engineering or Building Inspection may be able to offer the services of the County Soil Scientist. The Soil Scientist will meet with the homeowners and provide advice on methods as to how they can address their concerns.

THIS MEMORANDUM OF UNDERSTANDING ISSUED AND EFFECTIVE JULY 15, 1996

DAMS

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DAMS

- I. The design and construction of dams is a very technical part of Engineering, as there are many safety factors involved.

A. Existing Dams

1. If existing dam or dams on the property under development are to remain, regardless of size, they must be analyzed for structural stability. A dam, in this case, is assuming that water is impounded on a permanent basis behind the earth fill.
2. Dams shall be upgraded, as necessary, based on the report by a qualified engineer and shall be capable of the following:
 - a. Barrel and riser pipes are to be concrete.
 - b. Barrel and riser pipes to be no smaller than 15".
 - c. Adequate access must be provided for maintenance.
 - d. If 10-year storm exceeds the capacity of the principal spillway, the emergency spillway must be paved to the 10-year depth.
 - e. The 25' separation shall be maintained between the riser and the nearest embankment.
 - f. A sluice gate must be provided to lower the water level for maintenance.
 - g. Barrel and riser combinations must use a trash rack.
 - h. Emergency spillway (exceeding 10-year design):
 - 1.) In natural ground, grass linings permitted
 - 2.) In fill, paved to 100-year depth.

- B. Proposed Dams - If the proposed dam exceeds 25' in height and/or 50 acre feet of impounded water, it must meet State criteria and receive a State permit.

If the proposed dam and impoundment does not meet the above criteria, it shall meet the following:

1. Except in areas where wetlands are to be mitigated, the impoundment must be 3' in depth and 10' from shore.
2. If normal pool is above original ground, the dam must have an impermeable clay core keyed into impervious sub-surface soils.
3. Barrel and riser pipes are to be concrete.
4. Barrel and riser pipes are to be no smaller than 15".
5. Adequate access must be provided for maintenance.
6. If 10-year storm exceeds the capacity of the principal concrete spillway, the emergency spillway must be paved to the 100-year depth.
7. A 25' separation shall be maintained between the riser and the nearest embankment.
8. A sluice gate must be provided to lower the water level for maintenance.
9. Trash racks must be used with barrel and riser combinations.
10. Emergency spillway (exceeding 10-year design):
 - a. In natural ground, grass lining permitted.
 - b. In fill, paved to 100-year depth.
 - c. If, during analyzing of the proposed dam, the 100 year flood plain limits exceed the natural flood plain limits and affect off-site property not owned by the developer, the appropriate easements must be obtained or the dam modified accordingly prior to plan approval.

C. Off-Site Dams

1. Upstream

- a. Analyze the upstream dam for dam failure
- b. The limits of failure will be the basis for positioning of houses on the lots. The house can be positioned at the edge of this with the finished floor elevation 1' above the dam break line unless the Flood Plain Management Ordinance for the current setback exceeds the dam break analysis. The most restrictive would be adhered to.

2. Downstream

- a. The engineer must analyze the dam and associated 100 year flood plain based on ultimate development to determine the affect of the backwater on his subdivision. If upon completion of the study it is determined that the existing structure, as installed, produces an impoundment area which exceeds the 100 year flood plain, the developer must record the higher backwater.

APPENDIX A

STREET NAMING AND BUILDING NUMBERING

STREET NAMING AND BUILDING NUMBERING REGULATIONS

1. **Uniform System and Standards for Street Naming and Building Numbering.** This document establishes a uniform system for the naming of streets and the numbering of buildings fronting all streets, avenues and public ways, in accordance with requirements set forth in, and by authority of, **Chapter 16, Article II, of the Code of Chesterfield**. All streets are to be named and all buildings are to be numbered in accordance with the provisions of the article and are to be approved by the Director of Environmental Engineering. Street names and building numbers approved by the Director of Environmental Engineering or his agent will be considered to be official street names and building numbers and will be included in the County Address System.
2. **Proposed Street Names on Plats and Plans.** The approval process for new street names will be administered during the tentative plat, or plan, review. Street names are required to be submitted for each new street, whether the street is to be dedicated to public use, a private street, or an ingress/egress easement that meets the criteria stated below. Plats or plans submitted without street names, or with generic names, such as "Street A", are to be rejected and returned to the developer/design engineer until compliance with the requirements for labeling street names is achieved. The approved street names will appear on all subsequent submissions of plats or plans for review by the County. The following streets or traveled ways require County approved street names:

- A. Federal and primary state highways.
- B. Street proposed for acceptance into the secondary state highway system - dedicated to public use.
- C. Private streets to be maintained by homeowners' association or other private firm or organization.
- D. Ingress/egress easements that serve more than one address.

A special case requiring street names may also include where an insufficient number of addresses remain on an existing street for addressing new townhouse, condominium, apartment, or retail developments; the access entrance from the street is to be named, with addresses assigned to the named entrance and traveled way.

3. **Reservation of Street Names.** Developers and engineers may receive tentative approval of street names by reserving with the Richmond Regional and/or Crater Regional Planning Districts Commissions. By reserving a proposed street name, the County has not formally approved the street name for use, but has given conditional approval, subject to formal review during the tentative plat or plan review process. The County reserves the right to overrule use of street names approved by either of these commissions.

Street name reservation must be in compliance with the most current reservation time frame from both the Richmond Regional and/or the Crater Regional Planning Districts Commissions, contingent upon which has jurisdiction. Proposed street names may be reserved for two years only. After expiration of the two year reservation, if plats or plans showing such reserved names have not been submitted to the County by the developer reserving the name, the name may be used by any other developer in the County.

4. **Duplication of Existing Street Names.** No duplication of existing street names is to occur within Chesterfield County, Richmond Regional and/or Crater Regional Planning Districts, dependent upon jurisdiction. Street names with the same name, but different street type designations will be considered duplicate street names and will not receive approval with the exception of cul-de-sacs that intersect directly with a street of the same name. To ensure that street names are not duplicated, proposed street names will be reviewed against the County Address System as the primary source for existing street names.

5. **Near Spelling Duplications, Confusing Spellings, Phonetically Similar Names.** Near duplications in spelling, confusing spellings, or names that are phonetically similar to existing names are not to be approved. Near duplications of spelling are to be identified by reviewing the County Address System. Confusing spellings include those names that are difficult to spell, obscure names, or twists on conventional spelling of familiar names. Proper names are not to be approved., except for special recognition as approved by the County Board of Supervisors, nor will the names of commercial establishments be utilized.
6. **Length of Street Names.** New street names will not contain more than sixteen (16) characters, not including the type designation. Names shall not contain hyphens, apostrophes, nor any other non-letter characters. Street names will not consist of more than two (2) words, exclusive of street type.
7. **Continuation of Street Names.** Streets continuing through an intersection will keep the same name. Exceptions may be granted if the street crosses a major arterial road. Commercial, multi-family, or townhouse developments having an entrance or access through a publicly maintained cul-de-sac are to have a separate street name for the entrance or access road in the event that it serves or is intended to serve more than one address.
 - A. Cul-de-sacs directly opposite each other, intersecting with a common street are to have different names.
 - B. Street names will not change due to a change in direction of the street, nor will a new prefix be used for those streets that meet the criteria for using compass points in the street name
8. **Use of Compass Points in Street Names.** Compass points, such as North or West, shall not be used as a part of a street name, including as a prefix or suffix except as follows:
 - A. Where streets cross the East/West or North/South zero baseline for address assignment, with no change in base name and type, to ensure that the correct portion of such streets is correctly identified. For those streets that meet the criterion for this exception, the compass point direction is to made part of the official name of that street.
 - B. Where a street is constructed in stages from two ends and does not connect, compass points may be used until the street is physically connected. At that time, any such prefixes will be removed from the official street names. This process is to be automatic and is the responsibility of the Department of Environmental Engineering.
9. **Street Type Designations.** Street type designations will be approved or assigned by the Department of Environmental Engineering. Street names submitted for review must include street type designations and must be evaluated. If meeting the criteria for street types, they will be approved. Street types appearing on tentative, final check subdivision plats, site plans, or the subdivision record plats which do not meet criteria shall be noted for change by the developer/design engineer and approvals will be withheld until such changes are implemented. The following are the criteria for street type designation assignment or approval:
 - A. Major roadways such as an interstate, multi-lane federal highway - normally four (4) or more lanes, limited access, and divided:
 - Highway
 - Pike
 - Freeway
 - Expressway
 - Throughway
 - Turnpike
 - Bypass

- B. Major roadways - multi-lane, non-limited access, usually the main arterial roadways carrying high volumes of traffic:
- Highway
 - Avenue
 - Road
 - Boulevard
 - Parkway
- C. Local Connector roads - usually two lanes
- Avenue
 - Street
 - Road
 - Drive
 - Extension
- D. Local roadway providing access to individual lots within a subdivision or commercial area:
- Lane
 - Drive
 - Way
 - Circle
 - Trail
 - Loop
 - Bend
 - Heights
 - Hill
 - Knoll
 - Ridge
 - Run
 - Crossing
- E. Local street which have only one way in and out, such as cul-de-sacs:
- Court
 - Place
 - Terrace
 - Mews
 - Common
 - Commons
 - Crescent
 - Green
 - Landing
 - Manor
 - Point
 - Pointe
 - Summit
 - Trace
 - View
 - Vista

F. Ingress/Egress to shopping malls and centers:

Square
Arcade
Center
Plaza
Station

G. Traveled way usually behind housing and not used for normal through travel:

Alley

10. Conditions Under which Street Names May Be Changed. The following are the circumstances and procedures for changing a street name:

A. Presentation of a petition to the Department of Environmental Engineering signed by all residents of the street requesting the street name be changed.

1. Petitions will specifically propose three alternative street names in order of preference.
2. The Department of Environmental Engineering will review the proposed alternatives in order of preference for acceptability and approve the first alternative which meets the requirements of the article.

B. Determination by the Department of Environmental Engineering that, for the health, safety, and welfare of the citizens on a given street, the street name requires changing.

1. Citizens will be asked to rank, in order of preference, three proposed new names, with the highest ranking name becoming the new name.

C. Determination by the Department of Environmental Engineering that a given street name is in violation of this article.

1. Citizens will be asked to rank, in order of preference, three proposed new names, with the highest ranking name becoming the new name.

The information for each name change will be presented to the Chesterfield County Board of Supervisors for action as an Agenda Item.

11. Authority to Change Street Names. The authority to change street names rests with the Chesterfield County Board of Supervisors. The Board of Supervisors may change, rename, or name any existing or newly established street at any time. Upon approval by the Board of Supervisors of a name change, the Department of Environmental Engineering will be responsible for providing notification of the change, and its effective date, to the citizens concerned and all appropriate County, State and Federal agencies.

12. Street Address Assignment. All addresses are to be assigned not later than the time of final plat as submitted for review to the Planning Department, or on the final site plan for non-subdivision development. In all cases, Department of Environmental Engineering Addressing Section shall ensure that the developer/design engineer has provided sufficient information to properly address the new subdivision or site development plan. Addresses are to be assigned only by the Department of Environmental Engineering Addressing Section. Addresses assigned by any other entity are subject to being voided or otherwise changed. Subdivision addresses will not be available or released until the property has been recorded. All assigned addresses are to be entered into the automated County Address System.

Address assignment includes the assignment of unit numbers to shopping centers, apartments or condominiums, and office and warehouse developments consistent with the guidelines contained herein and as specified in the Article.

13. **Address Grid System.** Each new subdivision, parcel, commercial unit, apartment or condominium, or townhouse will be assigned an address based on the street providing access to the property. Vehicular parcel access will determine street name and address number assignment as opposed to the direction the building may be facing. Addresses will be assigned based on the County-wide grid system, which is a quadrant grid extended from the City of Richmond.

A separate number shall be assigned for every twenty-five feet (25') of street centerline. The address grid uses primary routes within Chesterfield County to indicate the zero baselines. Buildings on streets with similar names, such as cul-de-sacs with the same base name, but different type designations, will not have identical numbering sequences.

14. **Address Grid Baselines.** Streets that run north and south are to be addressed beginning with the number one (1) or two (2) at Midlothian Turnpike. Addresses for north-south streets north of this line will increase as they progress northward from Midlothian Turnpike. Addresses for north-south streets south of this line will increase as they progress southward from Midlothian Turnpike. For streets that intersect and cross Midlothian Turnpike without a base name and type designation change are to be identified with a prefix of N for north or S for south based on their relationship to Midlothian Turnpike.

Streets that run east and west are controlled by Jefferson Davis Highway. Addresses shall begin with the number 2600 west. Addresses for east-west streets west of Jefferson Davis Highway will begin with the number 2600 and increase as they progress westward. Addresses for east-west streets east of Jefferson Davis Highway will decrease from 2599 as they progress eastward. The east-west zero baseline runs north and south at the intersection of Meadowville Road and East/West Hundred Road.

Determination of north-south or east-west directional orientation will be made by the Department of Environmental Engineering.

15. **Application of Address Grid.** The primary consideration for assigning addresses on streets that diverge from the cardinal directions is the even distribution of address numbers in increments of 25 feet. Odd and even numbers are assigned as follows:

- A. Odd numbers are to be assigned to the east and south sides of streets.
- B. Even numbers are to be assigned to the north and west sides of streets.

16. **Addressing of Single Family Dwelling Lots.** Addresses for single lots within subdivisions are to be addressed, as appropriate, on the odd and even sides of the street, to include open space parcels. This information is to be entered and stored, with ancillary data, in the automated County Address System.

17. **Addressing of Townhouse Developments.** Addresses for townhouse lots are to be assigned consecutively, as appropriate, on the odd and even sides of the street. A separate street address is to be assigned for each townhouse lot, to include open space parcels. This information is to be entered and stored, with ancillary data, in the automated County Address System. No unit numbers, such as apartment numbers, are to be assigned in townhouse developments.

18. **Addressing of Vacant Parcels.** Each vacant parcel outside of a subdivision will have an address assigned using the lowest number available across the road frontage of the parcel. If, at a later date, a building permit is applied for on that parcel, the actual location of the driveway entrance will be shown the time of permit application and the building number adjusted to correspond to the location of the driveway. This information is to be entered and stored, with ancillary data, in the automated County Address System.

19. **Addressing Land Locked Parcels.** Land locked pieces of property will be addressed from the nearest road unless there is a major creek or stream between the nearest road and the property and the property lies in its entirety on the far side of the creek or stream from the road. In such cases, the next adjacent road to the property will be used to assign an address. The street address number will be derived from the appropriate address on the grid system closest to the center of the property. If, at a later date, a building permit is applied for on that land locked parcel and a proper legal right of ingress/egress has been obtained, the actual location of the ingress/egress will be shown the time of permit application and the building number adjusted to correspond to the location of the driveway. This information is to be entered and stored, with ancillary data, in the automated County Address System.
20. **Addressing Commercial, Office, and Warehouse Developments.** Assignment of addresses for shopping centers will vary depending on whether it is a strip center or mall. Commercial developments with variable retail space are to be evaluated for addressing based upon the minimum frontage and the maximum potential number of units. The requirements for addressing office and variable warehouse are the same as for strip shopping centers. Finalized assigned address information is to be entered and stored, with ancillary data, in the automated County Address System.
- A. **Strip shopping centers, variable office and warehouse spaces.** Strip shopping centers are to have an individual address for the center itself and each unit will be addressed in the manner prescribed for townhouses. Strict adherence to the 25 foot frontage dimension shall be followed. Site development plans for all strip shopping centers shall be required to include the maximum number of potential units within the center in order that allowances can be made for proper addressing. The location of the door providing primary public access is the determining factor in address assignment.
- In the event that a strip shopping center may require more street addresses than are available within the segment of street, the Department of Environmental Engineering Addressing Section may assign one street address to the strip shopping center as a whole and assign unit numbers for each of the potential units within the center. Unit numbers will run as consecutive whole numbers in the same direction as the addresses on the street. Unit numbers will begin with 101 and progress higher. The same procedures and information are to be used in assigning addresses and unit numbers to variable office and warehouse spaces.
- B. **Enclosed shopping malls.** Enclosed shopping malls are to be addressed with one street address number assigned to the street intersecting with the main entrance. Separate address numbers are not to be assigned to each entrance of enclosed shopping malls. The maximum number of retail units are to be included on the site development plans as well as the minimum retail unit frontage. Unit numbers are to be assigned using an odd and even numbers distribution on either side of the mall corridor(s). Unit numbers will begin with 1001 on the odd side and 1002 on the even side.
- In malls having multiple corridors and/or levels, each corridor is to be assigned numbers in higher hundreds divisions within a range of 1001 to 1999. Additional levels will be numbered similarly within the next highest thousands range. For example, retail spaces in one corridor may run from 1001 to 1028, retail spaces in an adjoining corridor would resume the sequence and run from 1029 to 1046, and stores on the next level up would be numbered 2001 to 2028 and 2029 to 2046, respectively.
- C. **Office Parks.** Office park address assignment will be in accordance with the established address grid system. Each building will be numbered as with townhouses (17, above) with each exterior entrance receiving a separate address.
21. **Addressing Multi-Family Dwellings and Multi-Unit Office Building Types.** These requirements include residential and office buildings of the same type construction design as apartment buildings.

Multi family housing units, such as apartments and condominiums, are to have a separate street address for to each entry providing primary access to units within the building, as defined by the development plans. Street addresses are to be assigned based on the established criteria for assignment in accordance with the grid system and using an appropriate odd and even scheme for building entrance. Finalized assigned address information is to be entered and stored, with ancillary data, in the automated County Address System.

Plans for multi-family dwellings, such as apartments and condominiums, to include conversions, and multi-unit office building types will have unit numbers assigned by the Department of Environmental Engineering Addressing Section in conjunction with the with the grid based street address. Plans submitted for review and address assignment must clearly identify the location of all entrances to each building and each unit therein and depict the physical relationships between these entrances.

Within vertical, multi-level structures, a consecutive whole unit number will be assigned for each separate unit. Numbers will be assigned from left to right as viewed from the common primary entrance. The lowest floor will begin with 101, progressing with 102, 103, 104, etc., until all units on that level have been assigned unit numbers. Unit numbers on successively higher floors are to be incremented by 100, such as 201, 202, 203, for the second level, 301, 302, 303, for the third floor and so on. The official complete street address for each unit will consist of the building number, street name, street type, and unit number in accordance with US Postal regulations.

The submitted site development plans, or condominium plats, must include a top view schematic of the buildings in their proper relationship to the street(s) providing access, as well as an elevation view or perspective diagram showing the relationship of unit entrances to the entry providing primary access from the exterior of the building(s). Final approval of plans will not be granted until the developer/design engineer has provided the Department of Environmental Engineering Addressing Section with information suitable for assigning addresses for these types of structures.

22. Street Name Signs. Every subdivider or creator of a new access to more than one building will furnish a fee, as set annually by the Chesterfield County Board of Supervisors, for the purchase and installation of street signs for every street intersection with the subdivision or new intersection created. The County will replace County installed street signs and/or posts as needed for street name changes, vandalism, accidental destruction, or normal wear and tear.

- A. All streets within Chesterfield County will be identified by a sign showing the official name of that street. This will apply to all public streets, private streets, ingress/egress easements and dedicated rights of way.
- B. Signs identifying street names will be placed at all intersections, identifying all intersecting streets.
- C. Where unnamed ingress/egress easements provide direct access to buildings and/or properties, address for such buildings and/or properties are to be identified with a sign showing the range of such addresses. The address sign is to be posted at the location where the ingress/egress easement and the street from which the buildings and/or properties are addressed intersect.
- D. Street name and address signs should be uniform throughout the County and are to conform to the standards established by the Department of Environmental Engineering.
- E. Special signposts and signage designed to conform to a particular community identity or theme may be authorized by the Director of Environmental Engineering on a case-by-case basis. Such signage must conform to County standards for size of sign, size of lettering, and reflective quality.

23. **Responsibility of Owners of New or Altered Buildings.** It is the responsibility of the owner of every new or altered building to obtain the official building number and attach the number to the premises. No building permit will be issued until the official building number has been issued and no certificate of occupancy may be issued until permanent and proper address numbers have been affixed to the structure in accordance with the article (also see 24 below). The cost of such address numbering materials will be borne by the property owner.
24. **Size, Type Material, and Location of Address Numbers for Single Family, Townhouses, and Multi-Family Dwellings.** House numbers will not less than four (4) inches in height and will be made of a durable and clearly visible material. The numbers are to be conspicuously placed on, above, or at the side of the primary access doorway or, for single family dwellings, on an adjacent mailbox so that the address number is clearly visible from the street approaches. Whenever a building is more than fifty (50) feet from the street, or when the primary access doorway is not clearly visible from the street, the number is to be placed on appropriate signage at the street end of the driveway or other street access point and will be visible from both directions of street approach. Placement of numbers on a roadside mailbox, conforming to size requirements, in such cases, will be acceptable.
25. **Size, Type Material, and Location of Address Numbers for Commercial, Office, and Warehouse Facilities.** Numbering will be placed above the exterior primary access entrance. Numbers will be not less than ten (10) inches in height and will be made of a durable and high visibility material. In the event that a strip shopping center, variable office structure, or warehouse structure has had unit numbers assigned, unit numbers will be posted in a like manner as well and will, also, be not less than ten (10) inches in height.
26. **Numbering on Signage.** Commercial properties such as, but not limited to, strip shopping centers, shopping malls, and office parks, displaying approved identifying signage will display an address number on that signage. In the case of shopping malls, the number will be the actual number of the mall's address. In the case of strip shopping centers, will be the lowest number of all numbers assigned to the facility. Numbers displayed on signage will not be less than ten (10) inches in height and may be placed above or below the signage and attached to that signage. Numbers must be clearly visible from the street.
27. **Authority for Changing Street Address Numbering.** The Director of Environmental Engineering, when he has determined a necessity based on health, safety, and welfare of the citizenry will have the authority to change the numbering of any existing or new address.

The Director of Environmental Engineering, or his agent, will determine appropriate new address numbers to supplant those to be changed. The Owners of the property will be notified by mail as to the impending change. In all cases, changes will become effective not less than 60 days subsequent to the notification letter mailing date.

The Director of Environmental Engineering, or his agent, will coordinate notification of changes with appropriate County agencies and the US Postal Service.

All other costs resultant from the change, i.e., those relating to the private and personal business of the individuals affected by the change will be borne by the owner, resident, or occupant of the property(ies) concerned.

APPENDIX B
STREETLIGHTS

STREETLIGHTS, NEW DEVELOPMENT

The following describes the procedures and responsibilities, reference the Chesterfield County Streetlight Policy, on succeeding pages, for the installation of streetlights in new development.

Initial submissions of plans, both commercial and residential, will include a separate plan sheet showing ultimate projected vehicle counts and resultant required streetlight locations as identified by the requirements of the Streetlight Policy.

Streetlight plan sheets will be evaluated by staff for compliance with the Streetlight Policy as it relates to new development. Minimum compliance is required; streetlights in excess of the minimum is acceptable. Plan sheets not meeting minimum compliance criteria as set forth in the Streetlight Policy will not be approved and complying revisions will be requested from the developer/design firm. Revisions will be required until compliance is achieved.

NOTE: Correct determination of a complying streetlight plan is the responsibility of the developer/design firm. Under no circumstances will staff make such determinations for the developer/design firm.

Approved streetlight plan sheets will be forwarded to the appropriate electric utility for installation cost determination.

Upon receipt of an installation cost quotation from the electric utility, staff will notify the developer of that cost. The developer must remit in this department an amount equal to the amount stipulated in the electric utility installation cost quotation **and** a separate administrative fee of \$50.00. Payment from the developer of both the installation cost and the administration fee must be received prior to staff authorization for the electric utility to proceed with the installation **and prior to recordation.**

The administration fee is waived for development plans not requiring any streetlights.

STREET LIGHT POLICY

612.00 STREET LIGHTING

612.01 NEW DEVELOPMENTS

I. Street Lighting facilities, including related wiring and easements shall be provided in subdivision and site developments and shall meet the following requirements:

A. Residential

1. Street lights shall be provided at the entrance to all new subdivisions if the new roads create a "tee" (T) or "cross" (+) intersection, provided the intersection carries in excess of 400 VPD.
2. Street lights shall be provided at all intersections where the minor street carries in excess of 400 VPD.
3. Street lighting easements 10' on 40' right-of-way and 5' on 50' right-of-way along the frontage of all lots throughout the subdivision are required. These easements will be recorded with the subdivision plats unless the street light service lines are placed within the proposed street right-of-way. Such easements will be required only on those streets where the minor street is projected to carry in excess of 400 VPD.

B. Commercial/Industrial Parks

1. Street lights shall be provided at the entrances of commercial/industrial parks and at new intersections where all roads collectively carry in excess of 2,000 VPD.

C. Lighting Requirements

1. The Road and Drainage Plans must show the location of the proposed street lights and easements. (Engineering must receive approval from the utility company prior to plan approval)
2. All easements must be shown on the final check plat and recorded with the final plat.
3. All installations shall conform to the Virginia Department of Transportation specifications. (See Land Use Permit Manual, Section 3.872)
4. All street lighting systems shall be installed, owned and maintained by the supplying utility company upon approval of the County.
5. The developer shall pay for the cost of installation.
6. Payment for the cost of installation will be required at time of recordation.

D. Standards and Criteria

1. Luminaire Style - All luminaries shall be as approved by the supplying utility company.
2. Light Source - All light sources shall be as approved by the supplying utility company.
3. Lumen Rating - There is no one set lighting level requirement that would apply to all public roadways in the County. Therefore, each roadway shall be generally lit as follows:
 - a. 8000 lumen - Used for secondary intersections
 - b. 14000 Lumen or greater - Used for primary intersections
 - c. Others - Used on primary roads and/or special cases when recommended by the supplying utility company
4. Pole placement and bracket length shall be as approved by the supplying utility company.
5. Concrete, salt treated or metal poles may be utilized in all new residential subdivisions.

612.02 EXISTING SUBDIVISION

I. Criteria for Street Light Approval

- A. Street lights should be limited to main entrances to subdivisions and/or internal connector streets with a VPD of 400 or more on the minor street or a combined VPD of 600 at the intersection. This would be based on the most current VDOT traffic counts.
- B. Street lights should be limited to "tee" (T) or "cross" (+) intersections and should be installed only on State or County rights-of-way or easements and on the street side of the pole.
- C. A petition must be signed by 75% of the residents within 200' of the proposed light is to include a majority of the residents living at the proposed locations.

II. Funding, Existing Development

- A. The County will pay for the installation of an approved streetlight providing installation money is available. The County will also pay for the monthly electric charges.
- B. The County will take over payments of existing lights if the street light criteria is met.
- C. If the light meets the street light criteria, but there are no funds available for installation in the current fiscal year, then the light will be placed on a schedule for fund availability. If the applicants desire, they may pay the installation charges associated with the light and the County will take over the monthly electric charge. This money must be paid prior to authorization of the light installation and is non-refundable.
- D. Unless directed to the contrary by a member of the Board of Supervisors, only those individual streetlight projects with a Virginia Power reported estimated cost of \$2,700 or less will be presented to the Board for approval.

III. Lamp Characteristics

- A. Light Source - All light sources shall be high pressure sodium vapor (HPSV).
- B. Lumen ratings -
 - 1. 8000 lumen - Used for secondary intersections
 - 2. 14000 lumen or greater - used for primary intersections
 - 3. Other - Used on primary roads or special cases when recommended by the utility company.
- C. Type of Pole - Concrete, salt treated wood, fiberglass, or metal poles may be used in existing developments dependent upon fixture.

Appendix C

Subdivision Plan Design / Review Checklist

Subdivision Name: _____

Date: _____ Reviewed By: _____

LEGEND: ✓ - OK / Satisfactory
X - Not Addressed
N/A - Not Applicable

Engineer / Sheet
 Response / No.

Subdivision Plan Format

Subdivision Development: Plans for roads, drainage and erosion control shall be submitted to the office of the Environmental Engineer for all proposed projects where roads are to be taken into the State Secondary System (9 sets, to include sewer and water line profiles) All plans must be folded and bundled accordingly. Include separate agency transmittals for EE(2), VDOT(2), CDOU(2), CDOT, FIRE, and PLANNING. Plans will not be processed nor forwarded unless 2 copies of approved tentative plan and signed tentative conditions letter are included in the submittal package for VDOT/EE. If sectioning is desired, each section must be submitted as a separate plan package and bundled accordingly.

Program Administration: The fee must accompany the initial plans submission and is processed by the front counter.

The following information (where applicable) is to be provided or considered on all plans submitted for review.

Cover Sheet shall contain the following information:

- ____ 1. Subdivision name and section designation
- ____ 2. Magisterial District followed by "of Chesterfield County, Virginia"
- ____ 3. Zoning case number and Board approval date (provide copy of BOS minutes or CPC approval letter)
- ____ 4. Tentative case number and tentative approval date (provide copy)
- ____ 5. Name of Developer/Owner, Walkin Address, Telephone Number
- ____ 6. Date
- ____ 7. Engineer or Surveyor, Address, signed certification stamp (insofar as allowed by State regulation laws), Telephone number
- ____ 8. Vicinity Sketch showing existing road names.
- ____ 9. General construction notes
- ____ 10. Provide note stating how CBPA compliance has been achieved for the project
- ____ 11. Sheet index

____ 12. Property Tax ID/GPIN

Construction Plan Sheets shall contain the following information:

- ____ 1. Indicate all proposed and existing rights-of-way widths, all lot lines, all lots with numbers, easements, all street names and existing State route numbers. Stipple all areas proposed to be paved.
- ____ 2. Indicate centerline stations at 100' intervals and at all other strategic points, i.e. drainage structuring, utilities, etc. and intersection of streets.
- ____ 3. When proposed and existing streets intersect, indicate existing conditions for 600 feet in each direction. This is to include width of pavement, right of way, location and direction of roadside drainage, any culverts to include inverts, utilities, etc.
- ____ 4. Indicate proposed driveway entrance culvert size (10-year), length, and location.
- ____ 5. Indicate all proposed and existing storm sewers, culverts and appurtenances, identify by type, size, length, material, inverts.
- ____ 6. Every inlet and segment of storm sewer shall be assigned a structure number. A drainage structure description shall be provided as applicable on each respective plan sheet.
 - ____ a. Indicate inlet and outlet elevations of all appurtenances including slot length.
- ____ 7. Indicate with arrows, the direction of flow in all gutters, storm sewers, ditches, subsurface drains, streams, minimum finished floors, etc.
- ____ 8. Indicate all existing and proposed ditches and streams and any relocations showing longitudinal slope and furnish detailed typical section showing type of stabilization to be provided and maximum and minimum vertical depth.
- ____ 9. Indicate direction of North on each sheet.
- ____ 10. Indicate location and description of all benchmarks and their elevation referenced to mean sea level. At least one (1) benchmark must be shown within the limits of the subdivision section.
- ____ 11. Indicate location of any County control monuments within vicinity.
- ____ 12. Plans shall be to a scale of 1"=50' or 1"=100' for lots greater than 1 acre, unless otherwise approved.
- ____ 13. Any notes that may be necessary to explain the intent and purposes of the plans.
- ____ 14. Indicate the location and width of all proposed and existing sidewalks and walkways.
- ____ 15. Show/label all USACOE wetlands, WOUS, 100-yr F/P, BW, RPA's.
- ____ 16. Dimension 25' building setback off the 100-yr F/P, 100-yr BW, wetlands/WOUS and RPA, whichever is most restrictive.
- ____ 17. Show Dimensioned Building Envelopes (DBE) where critical, as determined by EE.
- ____ 18. Indicate proposed and existing lakes and ponds onsite and in vicinity of projects. (NOTE: Separate detailed plans are to be submitted for all such structures).
- ____ 19. Adjacent property owners name, GPIN's and lot lines must be shown.

- ____ 20. Easements must be stationed in such a manner as to coordinate with profiles.
- ____ 21. Match lines must be shown with any overlap distinguished by dotting such overlap.
- ____ 22. Cut and fill construction limits must be shown, unless otherwise approved.

ADDITIONAL COMMENTS: _____

Profile Sheet(s) shall contain the following information:

- ____ 1. Existing centerline profiles and stations must be shown on all proposed streets, storm sewers, stream relocations, outfall ditches (to existing streams, and on drainage ditches to include location and elevation of utility crossings).
- ____ 2. Offset profiles of existing ground should be shown to the right and left of centerline at the right of way line – include legend.
- ____ 3. The finished grade line of all streets must show and include:
 - ____ a. Percent of grade
 - ____ b. Stations and Elevations at the low point and at all points of intersections.
- ____ 4. Stations shown on profile must agree with stations shown on plan. Stations must progress in the same direction on both plan and profile.
- ____ 5. Show existing/proposed profiles 300 feet beyond construction limits of roads that stub into adjacent properties or future sections.
- ____ 6. Show proposed culvert or storm sewer crossing at the proper location and grade, as well as sanitary sewer and water crossings.
- ____ 7. Each storm sewer system should be shown in its entirety to include, as a minimum, the following information: (alternate identify Structure number)
 - ____ a. Percent of grade and length
 - ____ b. Size and material
 - ____ c. Show catch basins, inlets, etc. with proposed elevation for tops and inverts.
 - ____ d. Show existing and proposed ground surface over centerline of system.
 - ____ e. Existing utilities passing perpendicular to the system or sharing a common easement (to include outer elevation)
- ____ 8. Open channels must include, as a minimum, the following:
 - ____ a. Percent of grade
 - ____ b. Centerline profile
 - ____ c. Existing ground profiles at centerline and easement edge (as deemed necessary).

- ____ d. Typical section showing 10-year design depth, side slopes, lining, and pertinent hydraulic data.

ADDITIONAL COMMENTS: _____

Detail Sheet(s) shall contain the following information:

- ____ 1. Show details of all proposed structures for which there is no standard drawing or modification of standards drawn to scale. Examples would be special drop inlets (DI-6), channel cross-sections, typical road cross-sections, sidewalk sections and erosion control devices, etc.
- ____ 2. If a VDOT standard is modified, detail must be shown with all applicable dimensions drawn to scale.
- ____ 3. List all construction notes necessary to complete the work.
- ____ 4. Number assigned to structure shall be shown with detail.

General Topographic (Drainage Areas & Erosion Control) Sheet(s) shall contain the following information:

- ____ 1. The drainage area plan shall not be incorporated into the EC plan but be a separate sheet.
- ____ 2. Show existing contours (maximum of five foot interval) to mean sea level datum (or lesser interval where deemed necessary by County).
- ____ 3. Show proposed and existing road right of way with road lanes, layout, property and lot lines; Residential and commercial building, parking lots, other physical features etc. (1"=50' or 100')
- ____ 4. Indicate schematically, all proposed and existing drainage structures, channels, etc. showing structure numbers.
- ____ 5. Indicate limits of drainage areas and the acreage of each area. When the off-site drainage area becomes larger than one hundred (100) acres, the limits of the area may be shown on a larger scale map (maximum 1"=2000') with a larger contour interval (maximum 10'). All drainage area maps must be scaled maps and completely contoured with contour elevation and part of the actual plan assembly. (not submitted separately)
- ____ 6. Indicate limits of computed 100-yr flood plains, wetlands, RPA's/RCMA's and identify.
- ____ 7. Use arrows to indicate direction of flow on all roads, ditches, pipes, etc.
- ____ 8. Show on contour map, the stations and lot numbers.
- ____ 9. The E&SC plans shall be a minimum of 2 phases.

Miscellaneous Submittal Requirements

- ____ 1. One additional overall project section sheet showing vehicle per day count, and streetlight location, as per the streetlight policy, must accompany the initial submission. The streetlight plan is reviewed by the chief of inspections.

Subdivision Plan Design

Design Requirements

- ____ 1. Received VDOT, CDOT, CDOU, FIRE, and Planning (if applicable) approvals prior to EE plan approval.
- ____ 2. Have zoning conditions been satisfactorily addressed in construction plans.
- ____ 3. Have tentative conditions been satisfactorily addressed in the construction plans.
 - ____ a. Does the construction plan road/lot layout and RPA limits match the approved tentative plan.
- ____ 4. Has site inspection been made to “field truth” existing conditions as shown in the construction plans.
 - ____ a. Do road beds or other features exist which should be graded/restored to surrounding ground elevation.
 - ____ 1. Earmark lots with NBP
- ____ 5. Are natural drainageways (unencumbered by wetlands/WOUS) adequate conveyance systems which should have 25' Building Setback Limit (BSL) dimensioned
 - ____ a. Specify that they are to remain in a natural state undisturbed.
- ____ 6. Does existing drainage flow pattern conflict with building envelope
 - ____ a. Has a contoured lot grading and drainage plan been provided.
 - ____ b. Earmark lot with NBP
 - ____ c. Dimension a Building Envelope 25' off Centerline of Drainageway.
- ____ 7. Has an approvable road design for sag conditions per VDOT Standards been provided a minimum 300' into adjacent property/future sections in plan and profile.
 - ____ a. VDOT Slope and Drainage easements and TCE's for fill slopes outside ROW.
- ____ 8. Are easements and/or improvements necessary to guarantee upstream offsite areas a permanent conveyance thru onsite development.
- ____ 9. Are proposed road fill slopes beyond the limits of ROW enclosed in VDOT S/D easements.
 - ____ a. Minimum 10' TCE's within lots adjacent to future road extensions.
- ____ 10. Does lot drainage cross more than 2 lots.
 - ____ a. Specify grass side yard swales (5:1 SS @ 12" depth) minimum 1% slope including a profile or spot flow line elevations.
 - ____ b. Dimension side yard swale 5' off the property line on the upstream side of downstream lot.

- ____ c. Grass yard swales across multiple lots to be enclosed in minimum 16' drainage easement to ensure permanent conveyance.
- ____ d. Earmark lots requiring grass side yard swales with NBP (No Building Permit)
- ____ e. Provide a 6" vertical opening with a 2' concrete gutter in the back of DI's within the ROW where available to intercept side yard swales.
- ____ 11. To assure positive lot drainage, do Minimum Crawl Space Elevations (MCSE) need to be specified a minimum 1' above original ground.
 - ____ a. Provide typical MCSE detail.
- ____ 12. Do the 100-yr calculations submitted show that the backwater elevation is at or below the 100-yr floodplain upstream/offsite.
 - ____ a. If the proposed 100-yr elevation is higher, a 100-yr backwater easement or revised floodplain limits must be recorded.
- ____ 13. Does proposed grading activity establish limits of 100-yr floodplain or backwater.
 - ____ a. Has filling in the 100-yr FP to achieve a building envelope been proposed – it is not allowed.
 - ____ b. Has the 100-yr FP limits been shown to verify that proposed filling is only to enlarge building envelopes, by separate submittal.
 - ____ c. Limits must be certified by a licensed professional prior to the release of the Building Permit and so stated in the plans.
- ____ 14. Could proposed building envelopes be impacted by a dam failure during the 100-yr storm event.
 - ____ a. Specify MFF(DF) elevation 1' above dam failure.
 - ____ b. Show Dimensioned Building Envelope (DBE) outside dam failure limits.

ADDITIONAL COMMENTS: _____

Hydrology

- ____ 1. Rational Method limited to maximum 200 acres
 - ____ a. 1.25 Saturation factor used for 100-yr storm calculations.
 - ____ b. OLF length does not exceed 200 feet
 - ____ c. flow path shown/labeled
- ____ 2. TR-55 method used for areas exceeding 200 acres
- ____ 3. Are runoff coefficients, CN's, T_c 's and drainage areas acceptable.
- ____ 4. Onsite DA Map on 50' or 100' scale for lots greater than 1 acre, unless otherwise approved.

- ____ a. Numeric contour elevations clearly shown
- ____ b. Contours clearly establish ridge lines

ADDITIONAL COMMENTS: _____

Hydraulics

- ____ 1. Culverts, storm sewer and open channels designed to minimum 10 year criteria
 - ____ a. 10-yr flow less than pipe capacity.
 - ____ b. 10 yr HW/D < 1 for private entrance culverts within ROW
 - ____ c. All calculations submitted on standard VDOT forms or other acceptable documentation.
 - ____ d. All pipes are Class III RCP at a minimum.
 - ____ e. Dimensioned channel section with 10-yr lining depth, side slopes, bottom width specified/shown in plan/profile
 - ____ f. Open channel slopes < 0.75% shall be paved.
 - ____ g. Open channel/Storm sewer minimum slope 0.2%
 - ____ h. Manhole steps required in structures 4 feet and greater in depth
 - ____ i. EC-1 or OP specified at beginning and ends of storm sewer/culverts
 - ____ j. IS-1 restricted to pipe diameters < 30"
 - ____ k. Pipe diameter $\geq 30"$ shall qualify for 50% reduction in junction losses only if precast manhole tee's and elbows specified
 - ____ l. First roadside ditch culvert adjacent to drainage break may be 12" RCP.
- ____ 2. Specify private/secondary RCP entrance culvert diameters and lengths on each lot.
 - ____ a. Minimum 20' length for private/secondary entrance culverts
 - ____ b. Minimum 100-year design
- ____ 3. Open Channel
 - ____ a. Rip rap channels not acceptable in front or beside single-family homes unless further than 100' from homes or otherwise approved.
 - ____ b. Rip rap channels can be used to rear of lots if no closer than 75' to homes.
 - ____ c. Where paved channels are steeper than 15%, anchor lugs are required every 10', C' – C'
 - ____ d. 8" vertical wall (freeboard) required along outside radius of paved ditches.
 - ____ e. Maximum permissible flow velocity of 3.5 fps for grass ditches.
 - ____ f. Open channel depths less than 3', otherwise shall be piped.
- ____ 4. Rip Rap lining a minimum 24" thickness with geotextile fabric underlayment.

- ____ 5. Has 3 inlet configuration or CG-6 with concrete driveway aprons specified on cul-de-sac's intercepting upstream road runoff.
- ____ 6. Maximum 18" RCP private entrance culvert within cul-de-sac bulb.
 - ____ a. Otherwise pickup ditch flow at reverse curve of cul-de-sac by culvert
- ____ 7. Culverts, storm sewer, and open channels analyzed for 100-yr property protection
 - ____ a. Are 100 yr contained within easements/ROW or 100 yr overflow limits shown
 - ____ b. Are 100 yr backwater limits/elevations shown
 - ____ c. Do single point access roads and secondary entrance culverts pass the 100 yr storm without overtopping the road sag. Maximum 6" overtopping with second point access.
 - ____ d. Are 100 yr Floodplain limits shown along natural drainageways.
 - ____ e. Are 100 yr Floodplain cross sections with elevations shown along floodplain limits
 - ____ f. Are MFF elevations specified at lots 1 foot above 100 yr floodplain (FP) or backwater (BW) or road sag (SAG) elevations, whichever is greater.
 - ____ g. Where flatter topography exists, 100 yr floodplain limits must be field verified by licensed professional and so stated in the plans.
- ____ 8. Headwalls required for pipes 30" or larger, or multiple lines or when slopes exceed 15%.
- ____ 9. DI-6 yard inlets required in county easements - horizontal grate/inlets not acceptable.
 - ____ a. Specified minimum 2' concrete gutters
 - ____ b. Specified slot opening locations (N,E,W,S)
 - ____ c. DI-6 detail included in construction plan details

ADDITIONAL COMMENTS: _____

Chesapeake Bay Preservation Act

- ____ 1. Confirm Worksheet A (pollutant removal requirements) calculations approved.
- ____ 2. Have BMP design calculations been submitted.
 - ____ a. Volumes where depths exceed 8' (entire water column) excluded from water quality volume.
- ____ 3. Provide separate BMP grading plan on 1" = 20' scale.
 - ____ a. Specify the normal pool and 10/100 year water surface elevations (WSE)
 - ____ b. Provide minimum 3:1 length to width ratio per E&SC Manual.
 - ____ c. Provide scaled centerline profile of the pond and embankment with applicable elevations, slopes, widths, etc.

- ____ d. Provide enlarged scaled principal/emergency spillway detail with applicable elevations, dimensions, material, etc.
- ____ e. Does principal concrete spillway provide 10-yr capacity.
- ____ f. Have sediment forebay(s) been provided at major inflow points.
 - ____ 1. Forebay dimensions should not exceed 20' due to cleanout limitations.
- ____ g. Emergency spillway may be grass or riprap lined in natural ground or paved in fill to 100-yr depth.
- ____ h. Does wet pond range in depth from 3' to 8'.
- ____ i. Top of dam shall provide minimum 1' freeboard above 100 year WSE.
- ____ j. Top of dam width minimum 8' and slopes 3:1 or flatter for maintenance.
- ____ k. Does dam embankment section specify an impermeable clay core keyed into impermeable subgrade.
- ____ l. Provide 12" valve/12" pipe with elbow off the bottom to lower pond for maintenance.
- ____ m. O-ring RCP pipe shall be used for barrels/risers.
- ____ n. Inflow pipes shall be partially submerged to the spring line (half the pipe diameter).
- ____ o. Riser and pipe barrels no smaller than 15".
- ____ p. Plastic Trash rack specified and dimensioned detail provided.
- ____ 4. Has SWM/BMP easement been shown enclosing entire facility and embankment/outfall.
 - ____ a. Established 25' off 100-yr WSE or toe of dam.
 - ____ b. Provided minimum 20' wide access easement.
 - ____ c. Provided minimum 12' wide, 6" base stone access road design & detail.
- ____ 5. SWM/BMP safety measures required for slopes steeper than 6:1 20' from the shoreline.
 - ____ a. When concrete weir depth exceeds 3', a pedestrian crossing structure shall be constructed across the weir.
 - ____ b. Basin 4' or less in depth and ≤ 1 acre surface area, safety bench required.
 - ____ c. Basin greater than 4' in depth or more than 1 acre surface area, both safety and aquatic benches required.
 - ____ d. Is safety bench 10' wide at 10:1 slope
 - ____ e. Is aquatic bench 6' wide at 6:1 slope
 - ____ f. Fencing around basin alternative to safety/aquatic benches- minimum height of fence 6'.
- ____ 6. Has 50' vegetative perimeter yard setback measured from 100-yr WSE or the toe of dam been shown/dimensioned. (must be within limits of project)
- ____ 7. Dimension/Label the "100' RPA Buffer Area" landward of wetlands contiguous to perennial stream to establish limits of the RPA.

- ____ 8. RPA signage located at every other lot along RPA and include RPA sign detail.
- ____ 9. Is RPA buffer area restoration required, If so please include detail.
- ____ 10. Are minor/major Water Quality Impact Assessments required.

ADDITIONAL COMMENTS: _____

Erosion Control

- ____ 1. Have the construction narratives been divided into 2 phases and shown on the EC plan, not elsewhere.
- ____ 2. Do the EC phase 1 and 2 plans ghost such features as ROW, property lines, centerline stationing, street names, lot numbers such that the EC measures and related activity “standout” in the plans.
- ____ 3. Have the standard EC notes from the handbook been included on the EC detail sheet.
- ____ 4. Are details with applicable information provided on the detail sheet for every EC measure specified.
- ____ 5. Has a temporary silt trap schedule been provided on the applicable EC plan sheet with volumes and dimensions (length, width, depth, and side slopes).
- ____ 6. Do EC plans show drainage area limits/acreage directed to temporary sediment traps/basins.
- ____ 7. Has a commentary been provided that addresses the sensitive areas (RPA’s, wetlands, steep slopes, etc.) and erodible soil types.
- ____ 8. Does the phase 1 EC narrative specify that the county inspector and CRLD must meet to inspect EC measures before proceeding to phase 2.
- ____ 9. Have the clearing limits been restricted to only that necessary to install the phase 1 EC measures-SF, DD, ST’s, SB’s, and stockpile area.
- ____ 10. Does the phase 1 plan specify that pipe barrel/riser must be onsite before issuance of Land Disturbance Permit (LDP).
- ____ 11. Does the phase 1 plan specify that the safety fence and flagging along the RPA/wetlands/sensitive areas must be visible before the issuance of the LDP.
- ____ 12. Do the EC plans for phase 1 provide a 1’ contoured grading plan for the construction of the sediment basin(s).
 - ____ a. Provide trash rack detail with dimensions.
 - ____ b. Provide Sediment Basin dam section with elevations and dimensions.
 - ____ c. Provide emergency spillway detail with dimensions.
 - ____ d. Provide reclamation grading plan for removal of the sediment basin.

- ☐ 13. Are temporary slope drains specified to convey sediment laden runoff from the road templates over the fill slopes exceeding 5' in height.
- ☐ 14. Does the phase 2 EC narrative state that additional EC measures may be required by EE if warranted by field conditions.
- ☐ 15. Does the phase 2 EC narrative state that no temporary silt trap's or sediment basins shall be removed until approved by EE.
- ☐ 16. Has itemized Cost Estimate been submitted for approval of bond amount.
- ☐ 17. Have MS-19 calculations with field taken sections ($H=V$) been submitted for onsite/offsite receiving facilities.
 - ☐ a. 2-yr analysis for natural
 - ☐ b. 10-yr analysis for manmade
 - ☐ c. Does section location satisfy 1% rule.
 - ☐ d. Are section locations shown/labeled.
- ☐ 18. Prior to issuance of Land Disturbance Permit:
 - ☐ a. Construction plans approved by Environmental Engineering.
 - ☐ b. Received documentation from COE/DEQ.
 - ☐ c. Received processed VSMP registration and fee form.
 - ☐ d. Provided DB-PG of all offsite easements.
 - ☐ e. If applicable, received processed VDOT land use permit applications.
 - ☐ f. EC bond posted.
 - ☐ g. Received signed notification from applicable adjacent owners unless otherwise required.

ADDITIONAL REVIEW COMMENTS: _____

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